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Research paper

Power Efficient and Workload Aware Scheduling in Cloud

Purshottam J. Assudani[1]*, Satheesh Abimannan[2]

[1]*Assistant Professor, IT, Shri Ramdeobaba College of Engineering and Management, Nagpur, India*
[2]*Associate Professor, SCOPE, VIT, Vellore, India*
**Corresponding author E-mail: pjassudani@gmail.com*

Abstract

The area of cloud computing is dynamic and versatile. Its arms are open for doing the research in every aspect, whether it is scheduling or provisioning. Furthermore, the research in both the aspects includes energy efficiency, profit maximization and cost minimization for cloud provider, as well as efficient and effective scheduling of resources to workloads. Also it is important to maintain QoS for the customer without violating the SLA. The aim of cloud supplier is to provide maximum utilization of resources with increased profit, while also reducing power and cost. The user demands high throughput and minimal response time. Allocating proper resources based on the workload with low energy costs to fully utilize the resources is the objective of cloud. The service requests are generated by various users in cloud. Hence energy efficient scheduling of resources according to workload is required for better performance of system and less operative cost. This paper gives a review on workload aware and power aware scheduling in cloud..

Keywords: *Resource management; Resource scheduling; Resource provisioning; Workload aware scheduling; Power aware scheduling.*

1. Introduction

The cloud provider provides software and hardware services to customer, as customer pays for those services. So it is required to manage those services and resources in an efficient manner. So that the response time should be lessen and availability should be high. Resource management constitute of number of stages from submission to execution of workload. We can categorize those stages broadly in two categories:

i) Resource Provisioning
ii) Resource Scheduling

Provisioning step of resources involved identifying the proper resources under a given circumstance of workloads and is based on how much is the requirement of Quality of Services (QoS) for Cloud users/consumers.

Resource scheduling is a technique of allocation of provisioned resources [1].The below fig.1 explains exact working:

In first phase, the cloud users/consumers submit the workload requirements to analyze the workload and QoS requirements, SLAs, etc. The information is then sent to Resource provisioning agent (RPA) which will then access the Resource Information center (RIC), which is resource pool containing information about resources and the result of the provisioning based on how much the workload is required as specified by consumer. RPA in turn sends the result of resource provisioning i.e. whether its successful or failed status to the user or consumer. If appropriate resources are available in resource pool then it provisions the required resource to workload.

In case, appropriate resources are unavailable as per the QoS requirement then RPA requests for workload requirement further as per new QoS requirements and SLA requirement. Once the necessary provisioning of resource is done, workloads will be then sent to resource scheduler. Resource scheduler then requests for provisioning the resources based on the workload. The process to find the list as to how many resources are available is known as resource detection or discover of resources. The process where it chooses the best resource available based on QoS requirement is known as resource selection.

The biggest challenge is that resource scheduling is diverse in nature, is due to the uncertainty of the workloads, which cannot be resolved with traditional resource scheduling methods in cloud [2]. Due to this fact, it is required to take care of the above properties and make the services and the applications more appropriate in the cloud.

Resource scheduling has 3 roles to play here:

i) To map the resources called as Resource mapping
ii) To execute the resources called Resource Execution
iii) To monitor the resources called Resource Monitoring.

In the next phase, the resource scheduling is executed once the resources are provisioned in resource provisioning steps as shown in Fig 1. First, the user submits the requirement for workload for executing. Next, mapping of the appropriate workload with the necessary resources are done as per QoS as well as SLAs needs.

For scheduling of resources, the QoS requirements are considered, for every user. The goal of the resource execution is to execute the proper resources to suit the workload requirement according to time, so that applications can efficiently use the resources.

While particular cloud workload is being executed, the monitoring agent checks the existing workload, as shown in fig 5. More resources will be requested, if the value of the required resources is greater than the value of provided resources. The needed resources are provided by resource pool by the process of rescheduling in order to meet the required number of resources for successful workload execution. Once the execution of workloads is done, then available resources are released in resource pool and then scheduler will start executing new workloads. Performance optimization will be best met if we effectively monitor the use of computing resources. So, an intelligent monitoring system agent is necessarily required. In SLAs, both Service Provider and User

would have possible deviations in order to achieve the required quality.

In SLA, Cloud Provider and Cloud Consumer both should provide the conceivable deviations to accomplish fitting quality traits. The SLA of Cloud supplier will show a sign of real SLA deviation of administration is doable, and to what sum it is pleasing to require its own monetary assets to make up for unforeseen blackouts.

The usage of CPU and memory are delineated by Resource Monitoring Agent. The resource observing framework gathers the resource uses by estimating through execution measurements, e.g., usage of CPU and memory. The supplier needs to hold enough assets to convey the ceaseless support to customer.

Resource monitoring is accustomed to deal with imperative QoS necessities like security, accessibility, execution and so on amid execution of workload. The aspects of resource monitoring are:

i) Customer needs execution of workloads with least cost as well as least time without violating SLA.
ii) Supplier needs execution of workload by using less resources.

Hence, resource monitoring is fundamental phase of resource management to quantify the SLA variation, QoS prerequisites and resource usage. It checks the performance of both physical and virtual infrastructures including security checking to accomplish classification, honesty and accessibility of information. At the end of the day, the number of resources ought to be least for a workload to maintain QoS parameter. The goal of resource scheduling is to allot the resources, without violating SLA to all the cloud buyers.

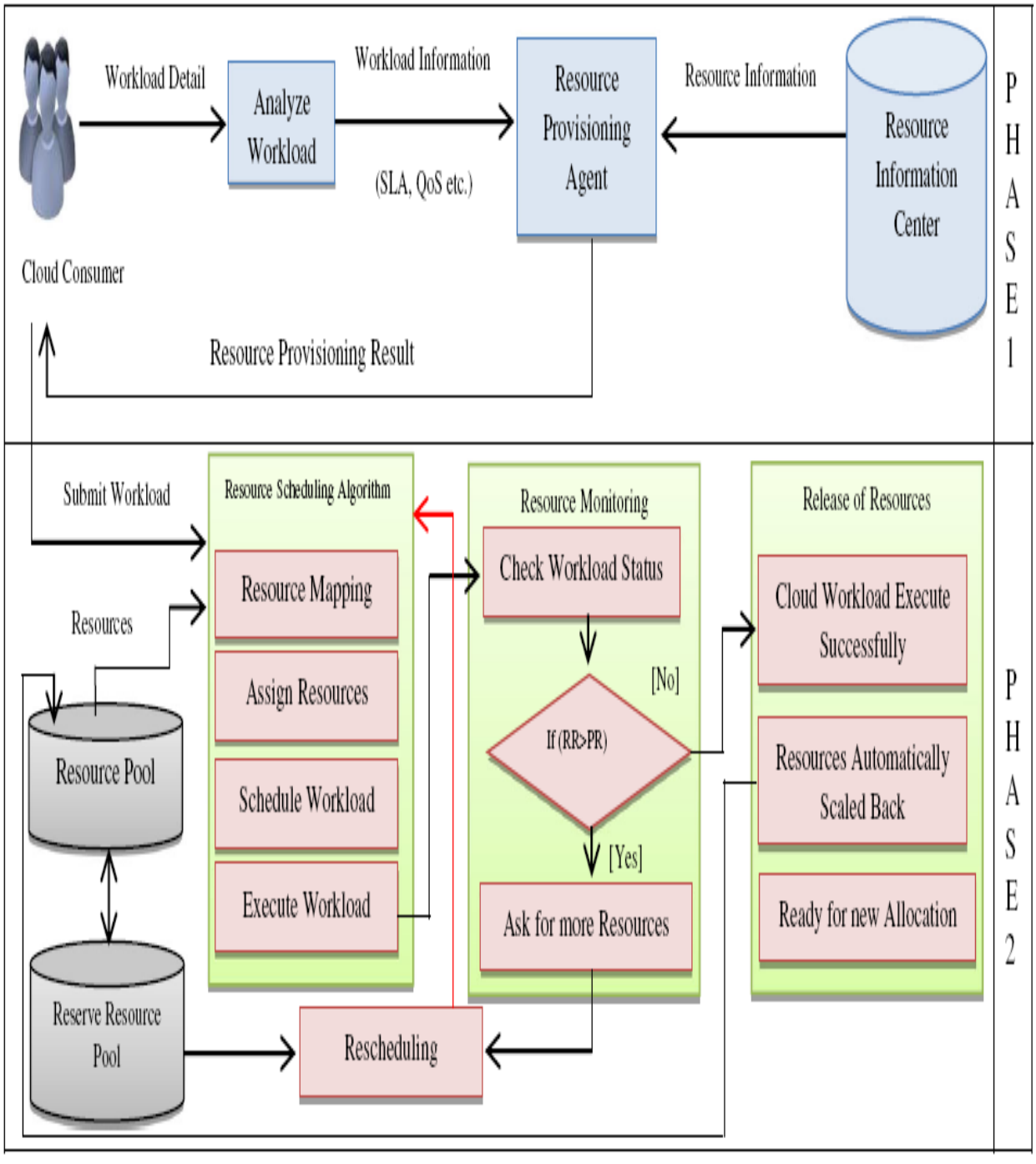

Fig.1: Provisioning and scheduling of resources in cloud

2. Workload Aware Scheduling

We can utilize the Workload Scheduler administration to make, run, calendar, and screen an arrangement of procedures that address particular needs utilizing the Workload Scheduler interface. You can see the survey of workload planning for cloud which encourages us to choose calculation or procedures and furthermore how they executed.

Valerio Persico et al. displayed a novel method for on a level plane scaling cloud resources. The proposed method depends on an advanced criticism control conspire that use fluffy rationale to self modify its parameters keeping in mind the end goal to adapt to erratic and very time differing open cloud working conditions[4].

Jia Zhao et al. concentrated on the choice issue of physical hosts for sending asked for undertakings and designed a heuristic method for LB-BC [5]. Most past works, by and large, use a progression of calculations through streamlining the hopeful target has inside a calculation cycle and afterward choosing the ideal target hosts to accomplish the prompt load adjusting impact. Be that as it may, the quick impact doesn't ensure high execution productivity for the following errand in spite of the fact that it has capacities in accomplishing high resource usage.

Xiaolong Liu et al. demonstrated a management system of cloud resource, as two novel turnaround time driven auto-scaling components for performance stability guaranteed [6]. In proposed method firstly, turnaround time monitors are installed at customer end instead of server end, and to derive a dynamic auto-scaling activity the data is gathered external to the server is utilized. Secondly, a auto scaling reconfiguration producer based on schedule, intended to experiment and recognize the quantity of required resources required.

Minxian Xu et al. revealed that the Brownout has been demonstrated compelling to resolve the problem of over-burden in cloud. Furthermore, brownout can likewise be connected to lessen power consumption [7]. They present the brownout empowered framework by taking into account application components, which are either compulsory or discretionary.

Lei Wei et al. designed a model for COVT systems and experimented its performance on real workloads. The Experiments demonstrate that the COVT can adequately provisions [8].

Chao Wang et al. proposed a novel FPGA-based acceleration scheme with MapReduce. The aligning short length reads could be accelerated by hardware acceleration with MapReduce jointly [9].

Lena Mashayekhy et al. proposed an online motivation good system, OVMAP, i.e., allocation and pricing of VM in Cloud [10]. The provisioning and allocation of resources could be done dynamically by OVMAP. As well as it decides the cost that clients must pay for their asked for VMs.

Min Du et al. detailed procedure to set the threshold according to the detection results dynamically, and further, how to change the method to guarantee its optimality under dynamic workloads [11].

Long Qu et al. revealed the VNF scheduling issue and corresponding solution for resource optimization. For VNF scheduling, it is required to define a series of scheduling decisions and turn on different VNFs to process the arriving traffic [12].

Ilia Pietri et al. proposed a novel method for dataflow scheduling on heterogeneous cloud that investigate the search space in an effective manner to recognize the optimal solution [13]. Experiment result shows that the proposed method gives a wealthier, various set of solutions for better time cost tradeoffs.

V.Meena et al. discovered a effective mapping procedure for offload task and VMs as far as cost and power utilization is concerned [14]. They have experimented for sending the offloaded task on homogeneous and heterogeneous arrangement of virtual machines.

Qiang Li et al. proposed a technique based on stochastic integer programming to take care of the ideal resource scheduling in cloud [15]. To solve the issue of stochastic integer programming by applying Grobner bases hypothesis and the test consequences of the execution are likewise introduced.

Pavithra B et al. introduced a relative analysis for performance among different load adjusting strategies by considering different measurements e.g. energy utilization, execution and response time and processing cost. Hence, finding and choosing the most ideal and famous load adjusting strategy that gives better execution and performance in resource usage [16].

Mnahil Kher Alseed Mohammed Alnazir et al. uses CloudSim tool for performance evaluation [17]. It can likewise be utilized to evaluate fitness of systems from different points of view, for example, cost, application execution time and so on. It can be as used by the client, as basis for simulated Cloud condition.

C. Antony et al. Compared parallel job scheduling techniques and proposed Hyper Heuristic Scheduling System HHSA technique for proficient discovery operators and irritation framework isn't broke down in cloud[18]. Additionally, the computation cost and deadline constraints are not worried for proposed method.

Danlami Gabi et al proposed a structure for task scheduling, aiming for execution cost and time parameters and compared similar task scheduling algorithms[19]. The result of proposed method demonstrates better performance as execution time and price and gives better versatility execution.

Ritu Kapur displayed another algorithm LBRS which plays out the resource planning for an adjusted pennant [20]. The recreations and results showed in the paper demonstrate that the LBRS calculation.

Sobhan Omranian Khorasani et al. presented a heuristic scheduling method for deadline constrained. The method aiming to filter distributed deadline and achieving lower communication cost, which utilizes Level Load Balancing [23].

Table 1: Comparison of different algorithms used for Load balancing in cloud

Sr.	Authors	Algorithm/Tech./Method	Result
1	Jia Zhao et al. [5]	Bayes and Clustering based Balancing of load (LB-BC)	Attain the immediate balancing of load
2	Minxian Xuet al. [7]	Brownout	Reduce energy consumption and resolve the issue of overloading
3	Lei Wei et al. [8]	COVT	Supplies least amount of resources for defined QoS.
4	Chao Wang et al. [9]	FPGA with MapReduce technique	Accelerate alignment of short length reads
5	Mnahil Kher Alseed et al. [17]	Cloud-Sim	Can be used as basis for simulation in Cloud and can add new policies also
6	Danlami Gabiet al. [19]	Scalability aware Scheduling Optimization Algorithm	Minimizes execution time and cost of tasks and provide improved scalability
7	Awatif Ragmani et al. [22]	Ant Colony Optimization	Better response time.

3. Power Efficiency Aware Scheduling

The fast increment for computing demands and high need of storing the data, leads to energy and power consumption. We considered number of papers identified with power efficiency in cloud which helps to choose best method for expanding power effectiveness.

Jungmin Son et al. compared various methods related to power consumption [24]. Initially, they examined the cause of the power saving where it originates from by demonstrating the extent of the power spared in host and switches.

Dazhao Cheng et al. proposed and built up a flexible power aware method for resource provisioning (ePower) for heterogeneous cloud that totally depend on sustainable power sources [25]. They expect to augment the system through put and control the power utilization as for green power supply.

ShahinVakilinia et al. revealed that combined strategy of optimization scheduling and estimation techniques, results less the power utilization of DC [26]. An estimation module is installed to anticipate the upcoming loads and after that to schedule normal and unexpected burdens, the schedulers are designed separately.

Xiang Deng et al. suggested an online solution Eco Power, to perform eco management of power and scheduling of loads together for physically scattered data centers [27]. To reduce average eco power and guaranteeing QoE is the goal of proposed algorithm, imperative of client demands.

Zheng Chang et al. revealed an algorithm for allocation of resources and scheduling of user for limiting the power cost of information transmission with regards to orthogonal recurrence division multiple access (OFDMA) cooperative portable clouds (CMCs) with concurrent remote data and power transreceivers [28].

Xiaolong Xu et al. proposed an Energy aware Resource Allocation strategy, i.e., EnReal. Basically, they use the dynamic deployment of VMs for logical work process executions [29]. In particular, a power utilization model and energy aware method to allocate resources has been proposed to achieve logical work process executions.

Li Shi et al. concentrated around the issue of planning parallel jobs and considered power utilization in scheduling [30]. They aim to reduce will Job Completion Time likely by deciding determine task placement schedule and resource allocation schedule of jobs.

Wanyuan Wang et al. Minimizes the power cost by introducing a distributed MA based resource allocation [31]. The proposed MA approach comprises of two mechanisms: 1) an auction based VM allotment mechanism, 2) a negotiation based VM consolidation mechanism.

Peng Sun et al. Proposed a reliability performance energy correlation framework. The new model catches huge impacts of arbitrary failure of resources and recovery on MACS execution and power utilization to guarantee high constancy and exact assessment [32].

Saira Manzoor et al. examined various methodologies that have talked about power proficient work in cloud, and analyzed these methodologies. The outcomes demonstrate that scheduling and allocation methods of virtual machine designation approaches are the most ordinarily utilized methodologies that accomplish ideal power utilization [33].

Hongjia Li et al. proposed a quick resource provisioning based on power and scheduling of task method to accomplish least power cost and decreased computational complexity for CSPs. In iterative method, to effectively diminish the run time and complexity, they isolated the provisioning and planning to different advances while accomplishing a sensible power cost [34].

Megha Sharma et al. proposed Energy aware Discrete Symbiotic Organism Search (E-DSOS) method for small clouds. The result demonstrates that EDSOS takes lesser power as problem size increments [35].

Songtao Guo et al. gives a power effective dynamic offloading and scheduling of resource (eDors) strategy to decrease power utilization and application's finish time. They initially define the eDors issue into the minimization problem of efficiency cost while fulfilling the task dependency and the finish time deadline limitation. Moreover, they find that the calculation offloading choice relies upon not just the task workload, but also the direct predecessor's utmost finishing time [36].

Jincy Joseph et al. proposed scheduling of VM and process depending on the buffer size of both Virtual Machines and procedures. The proposed method attempts to decrease the waiting time and the context switching number, to lessen the delay and power consumption in packet exchange between VMs [37].

Table 2: Comparison of different algorithms used for Power Efficiency in cloud

Sr.	Authors	Algorithm/Tech./Methods	Result
1	Dazhao Cheng et al. [25]	elastic power-aware resource provisioning approach	Maximize the through put while controlling the power consumption
2	Xiaolong Xu et al. [29]	Energy-aware Resource Allocation Method	Virtual machine scheduling to accomplish scientific workflow executions
3	Peng Sun et al. [32]	Reliability performance-energy correlation model	Captures major impact of random resource failures and recovery on MACS
4	Jungmin Son et al. [33]	dynamic overbooking method	Allocates accurate number of resources to VMs and traffics.
5	Megha Sharma et al. [35]	Energy–aware Discrete Symbiotic Organism Search Optimization	EDSOS takes low power in accordance with increase in problem size
6	Songtao Guo et al. [36]	distributed eDors algorithm	To minimize energy consumption and reduce the time to complete an application
7	Cihan Tunc et al. [41]	Service Based Task Scheduling	50% improvement in performance value, 40% improvement in energy value.

Jagadeeswara Rao. G et al. explained that the policy used in cloud for services, clusters, virtual machines. As the request increments on the data centers prompts high power utilization and carbon discharges. So here they are giving a correlation of green cloud planning calculation with other undertaking scheduling methods [38].

Harvinder Singh, et al. examined, dissected and talked about different methods to determine the issue of scheduling by taking diverse parameters, by allocating VMs to server or by relegating tasks to different VMs. The heuristic planning methods like ACO and diverse variations be talked about; assist change should be possible to make it more vitality proficient method [39].

Bing Yu et al. proposed a approach to assess the significance and connections among different VMs. The possible score in view of data field is a much exact in view of resource requests and traffic between VMs. The simulation results demonstrate that their proposition can diminish the quantity of dynamic components as well as the servers and system components, and consequently spares power utilization. In addition, the approach enhances performance of network by diminishing the hops per stream [40].

Cihan Tunc et al. composed, assessed, and contrasted task scheduling strategies with considerable change in power consumption. The experiments done on an IBM blade server utilizing KVM and test outcome shows utilizing time subordinate VoS, half change in execution esteem [41].

4. Resource Aware Scheduling in Cloud

Resource scheduling alludes to the set of activities and techniques utilized by associations to effectively allot the resources based on availability of resources. Following papers demonstrates distinct methods and strategies used to schedule resources in cloud, which causes us to choose best strategy for resource scheduling.

Mahyar Movahed Nejad et al. planned the dynamic provisioning and assignment of VM for the auction based model as a integer program thinking about various kinds of resources. They created truthful, greedy and optimal solution for VMs provisioning by cloud provider in light of the request of winning clients and decides their expenses [42].

Guoxin Liu et al. proposed a multi-cloud Economical and SLO ensured cloud Storage Service (ES3) for a cloud specialist over various CSPs that give SLO guarantee and cost minimization [43].
Mingxi Cheng et al. exhibited DRL-Cloud, a novel DRL-based framework with resource provisioning and task scheduling as two phases, to lessen the power for cloud provider with huge scale data centers with a lot of client demands with conditions. It is exceptionally versatile and the training method converges quick, on account of the training procedures in two phase RP-TS processor [44].
Zhuoyao Wang, et al. has proposed a novel probabilistic system to a structure the services of clients in cloud. The structure keeps in mind the features including multi-tenancy characteristic, the heterogeneity of VMs in the virtual infrastructure and the response times for serving a request. The percentile and mean of the stochastic response time of client demands have been logically portrayed. These two amounts are broadly utilized measurements for assessing the execution of cloud benefits in the research [45].
Andreas Wolke et al. Performed experimentation and demonstrate for transactional business applications based typical workloads. The dynamic allocation of resources does not expand power proficiency over the static allotment of VMs to servers and may include some significant downfalls, since movements prompts overheads and administration disruptions [46].
Alok Gautam Kumbhare et al. roused the requirement for online monitoring and adaptation of persistent dataflow applications to gather their QoS limitations within the sight of information and varied infrastructure. They presented the idea of dynamic information streams, with help for alternate implimentations for dataflow tasks [47].
Jun Du et al. considered the resource assignment issues for video transmission in space-based data systems. The queuing framework constituted by various clients and a solitary server, where the server is worked as a cloud that can detect the activity entries to every client's queue and afterward distributes the transmission resource and service rate for the clients [48].
Lei Jiao et al. announced a regularization based strategy to outline dynamic calculations for the situations with and without accessible forecast, separately. The authors conquer the test originating from reconfiguration prompted, coupled choices by developing a series of sub issues, every one of which is resolvable at the available slot [49].
Hariharasudhan Viswanathan et al. designed a novel system for provisioning of resources with the aim of arranging the heterogeneous detection, computation, and communication capacities of static and mobile gadgets so as to create a computing grid for mobile devices [50].
Xingwei Wang et al. proposed a smart combinatorial double auction based dynamic resource distribution approach based on economy and bio-inspiration, for services in cloud [51].
Wenhua Xiao et al. derived a precise strategy called Dynamical Request Redirection and Resource Provisioning as a stochastic advancement and outline a Lyapunov optimization structure based online method to illuminate it [52].
Hamed Shah Mansouri et al. proposed a MCC market to outline a dynamic task scheduler for mobile gadgets and to acquire CSP's pricing technique. They initially designed a task scheduler by considering power utilization, delay, and cost of cloud [53].
Awais Ahmad et al. displayed a framework design in view of the hierarchical system for resource sharing for MCC. The framework design is isolated into areas like, Global Cloud Server (GCS), Local ISP Server (LIS), and Gateway Server (GWS). Likewise, the proposed approach for limiting the delay in system in light of sending Foglets at every proposed method for clustering mechanism is additionally present[54].
Mohamed Graiet et al. proposed a formalism in view of the Event B language in business process models for determining Cloud resource assignment approaches [55].
Guisheng Fan et al. proposed an orderly strategy to deal with the reliability, time to execute, and failure handling of resource scheduling for cloud. A reflection system is utilized to digest the resource scheduling process [56].
Lujia Wang et al. proposed a progressive auction based approach, to be link quality matrix (LQM) auction, which is reasonable for adhoc systems by presenting a link quality pointer. The proposed approach creates a quick and robust technique that is exact and versatile [57].
Jing Bi et al. exhibited another way to improve the benefit of VCDC in view of the service level agreements (SLAs) involving service provider and clients. It considers a few generally overlooked elements in the SLA like the measure of completed requests, the measure of rejected requests, and cost of power [58].
Yongyi Ran et al. considered the a reserved on demand instances economical provisioning for compute intensive applications. With a specific end goal to accomplish this, they consider a methodology for deciding the measure of the purchased instances dynamically to reduce processing cost while maintaining QoS [59].
Nan Zhang et al. considered the key dynamic resource distribution issues in downlink DSL: given the ongoing requests, decide the optimized transmission scheme: The ideal NOI and DOI estimate in every data outline and in addition the ideal gathering system in the DOI, and ideally alter the transmission conspire [60].
Abhishek Gupta et al. upgraded attributes and enhanced the execution of HPC applications in cloud for virtualization approaches. At last, the heuristics for online application aware job scheduling is displayed in multi-platform environment [61].
M. Recalcati et al. proposed an approach for connection resource provisioning in EONs. They investigated the performance of flexible grid EONs and demonstrate quantitatively the upside of EON contrasted with grooming based WDM systems [62].
MeikangQiu et al. displayed an optimization approach based on genetic method for chip multiprocessor (CMP) equipped with PCM memory in green clouds. The approach not just designed to schedule and allots the tasks to cores in the CMP structure, yet in addition gives a PCM MLC scheme that adjusts the PCM memory execution and enhances efficiency also [63].
Dan Xu et al. proposed a provisioning method for joint server, TOL load shifting, SEN load dispatching and SEN/TOL capacity allotment conspire, which use TOL queue data and not expect any framework measurable data [64].
Muhammad Faisal Iqbal et al. proposed a packet scheduling plan that thinks about the numerous dimensions of region to enhance the performance of a system processor while limiting out of request bundles [65].
Bin Li et al. proposed a scheduling policy and plan of joint flow rate control strategies in multi-hop wireless systems for accomplishing greatest system utility with optimum convergence speed [66].
Jiann Liang Chen et al. proposed a dynamic resource management plan named as Enterprise Visor engine to deal with the appropriate resource allotment among slices [67].
Omer Adam et al. proposed a novel resource allocator (2SPRA) that tends to vulnerable as a stochastic procedure in workloads, to provision the resources for containerized n-level applications in clouds. The proposed method improves provisioned resources in the application [68].
Cemil Can Coskun et al. examined the energy efficiency of downlink transmissions in heterogeneous systems, and aims to fulfil the rate prerequisite of clients while boosting the vitality proficiency of the system [69].
Jyotiska Nath Khasnabish et al. proposed Tier-centric Business Impact and Cost Analysis (T-BICA), a tier driven optimal resource allotment approach, to deal with the issue of fast provisioning of IT assets in current endeavour cloud conditions. The approach id designed by broad information gathering and execution investigations of business benefits in a simulated situation [70].
You Hui Zhang et al. proposed GCloud, a GPU/CPU hybrid cluster for cloud gaming in light of client level virtualization innovation. They introduced an execution representation to investigate the server capacity and games resource utilizations [71].

Xing Liu et al. proposed a new strategy based on channel scheduling, for its applications in multiuser multiservice situations in MCC systems. It employs a back off scheme to coordinate between services in real and non real time in the channel [72].
Wang Yan et al. proposed a workflow structure and resource model in view of queue theory and consider the QoS prerequisites of time and cost limitations. An Improved Genetic Algorithm is proposed to advance framework proficiency in resource scheduling. The experimental results show that MGA contrasting with FCFS (First Come First Service) calculation and GA (Genetic Algorithm) meets clients' QoS needs and the task's effectiveness [73].
Haitao Hu et al. Proposed an ACO approach for scheduling the jobs with different QoS on VMs and afterwards arrange clients QoS requirements and resources as their capabilities [74].
M.Vishalatchi et al. Exhibited a TS method, which uses bandwidth resource and the deadline along with payments for auction. The results demonstrate that the auction in Tabu scheduling has a considerably higher benefit to the cloud provider [75].
Mahmudun Nabi et al. exhibited concrete dimensions on the computational capacity of vehicular clouds. Their discoveries is not just helpful to engineers thinking about a genuine vehicular cloud arrangement, yet in addition for additionally examine on methods for concrete resource scheduling issues in vehicular clouds[76].
Lei Zhang et al. proposed a algorithm NG-TSRA, which forms the association of heterogeneous servers in the cloud computing structure as a non-cooperative game. It can provide higher power effectiveness when the task of system is processed, [77].
Ekta Rani et al. give essential observation on Cloudsim Simulator and shows easy tests to learn how to utilize it in Cloud [78].
Yash Vijay et al. built up an arrangement of environmental conditions and situations with a specific end goal to separate the working of the scheduling algorithms. In light of these examinations, a clever device was produced which takes in the client preferences, and recommends the scheduler regarding the quantity of VMs, and the Scheduling approach which ought to be utilized for obliging the client prerequisites [79].
Punit Gupta et al. proposed learning based cost effective solution to defeat the issues with existing methods for cloud Infrastructure. Proposed solution utilizes genetic algorithm for cost proficient task allotment to reduce the cost and high usage to give better QoS (Quality of Service) to the customer. Proposed methodology test comes about shows better execution in term of execution cost, execution time, scheduling time when contrasted with existing approaches [80].
Ananthi Sheshasaayee et al. displayed diverse kinds of autonomic resource management approaches. It gives the general points of interest and confinements of different autonomic provisioning strategies. The autonomic resource provisioning is utilized to diminish budgetary and ecological cost with more effectiveness. That paper has profited both Cloud clients and analysts to better comprehend about autonomic resource management [81].
Khaled Almi'ani et al. planned the RDAS method that schedule workflow in view of requests. RDAS divides the workflows and distribute the resources of various capabilities/kinds to the allotments in "fair" way with the end goal that their execution times don't differ considerably. RDAS provides an opportunity for enhancing resource provisioning for logical workflows [82].
Jinlai Xu et al. proposed an agreements based scheme to boost the profit locally and reduce cost globally for sharing of resource among CSPs in a federated cloud. They built up auction based system for establishing the contract and a set of contracts with focusing on cost and duration scheduling schemes that increase the benefits of the CSPs [83].
Marwa A. Abdelaal et al. displayed the issue of virtual machines allocation is handled in view of Software Defined Network (SDN) resource designation methodology. Also, a few essential parameters are considered over that has been disregarded in past related investigations. Another objective is to limit the general price for allocating the resources in cloud [84].
Mohit Agarwal et al. introduced the Genetic Algorithm based task scheduling method, which will disseminate the load adequately among the virtual machines to reduce response time (QoS). The experiment comparison on Cloudsim shows that, this will outflank the older methods like Greedy based, first - Come first - Serve (FCFS) procedures [85].
Eddy Caron et al. considered various optimization factors such as cost of resource and computation time and proposed effective scheduling for executing the tasks with high granularity for cluster and cloud environment. [86].
Qiao Chu et al. proposed an SMB (Stable Marriage Based Algorithm) scheme, which is guaranteed to provide stable matching for computing, storage resources as well as applications [87].
Wu Hong Qiang et al. Proposed a scheduling method based on improved FCM (IGAFCM) Algorithm to reduce the size of mobile resources clusters. Also, Experiments have demonstrated that matching score and feedback training can be used to dynamically adjust matching strategy [88].
Neeraj Kumar et al. proposed Adaptive Job Scheduling algorithm for resource selection, scheduling of user request and new resource allocation to improve QoS, and reliability of resource availability and reduces the job completion time [89].
Neethu B et al. focused on better online marketing for resource allocation dynamically, from both customers and providers perspective. To predict best consumer and provider, the modified Paddy Field Algorithm (PFA) is used [90].
Ananthi Sheshasaayee et al. Discussed a MapReduce technique based framework for resource scheduling in Cloud for big data based applications, to reduce the cost and time of execution [91].
Harpreet Singh et al. proposed Cuckoo Search algorithm for finding workflow task scheduling. The algorithm optimizes make span to find an optimal mapping of workflow tasks on cloud resources [92].
Yan Wang et al. modelled a Utility Maximization Model for resource scheduling problem for better placement of VMs. They also proposed Gradient based Projection algorithm to improve the efficiency of resource scheduling [93]. Yuwei Wang et al. proposed a mechanism called DiffScheduler to recognize Virtual

Table 3: Comparison of different algorithms used for Resource scheduling in cloud

Sr.	Authors	Algorithm/Tech./Methods	Results
1	Awais Ahmadet al. [54]	the hierarchical method for resource distribution	Minimizes delay in the network
2	Lujia Wang et al.[57]	hierarchical auction based mechanism i.e. link quality matrix (LQM) auction	Produces a fast and robust method that is accurate and scalable
3	Jyotiska Nath Khasnabish et al. [70]	Tier-centric Business Impact and Cost Analysis (T-BICA)	Immediate provisions the resources in modern enterprise
4	Wang Yan et al. [73]	Improved Genetic Algorithm	Optimize system efficiency in resource scheduling stage.
5	Haitao Hu et al. [74]	ant colony optimization (ACO) algorithm	Determines the finest dispatch of tasks to Virtual Machines
6	Lei Zhang et al. [77]	NG-TSRA - task scheduling and resource allocation method	Minimizes the energy consumption with efficient handling of task
7	Punit Gupta et al.[80]	Monkey Search Algorithm	Gives higher performance in view of execution cost and time, scheduling
8	Khaled Almi'ani et al. [82]	Resource Demand Aware Scheduling (RDAS) algorithm	Minimizes workflow make span and execution cost

Machine for Network Queuing Sensitive. The mechanism performs effective scheduling [94].
Xing Jia Wei et al. proposed a combined approach of simulated annealing and multi-population genetic algorithm named as SAMPGA for task scheduling in cloud. The algorithm avoids local optimum and improves convergence speed [95].
Xiao-long Zheng et al. proposed a PFOA method for scheduling task and allocation of resources. They proposed heuristic methods for least cost, resource reassign operator, and critical path based search operator [96].
Xiaomin Zhu et al. proposed a framework based on guidelines of software engineering, to dynamically schedule task and provision the resource. They included objectives of scheduling and task processing under varying constraints [97].

5. Conclusion

Cloud computing has become to be an increasingly prominent area for research and development. It is required to do scheduling in efficient manner with maintaining QoS and without SLA violation. The key objective of this paper is to focus on efficient power aware and workload aware scheduling. In this review work, we have studied total 98 research papers, related to power, workload and resource aware scheduling.
Managing the workload and fair allocation of resources is the aim of workload aware scheduling. Proficient execution of workflows and task with low power consumption is the aim of Power with workload and energy efficient scheduling in cloud.

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