Research Article

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Task scheduling algorithm based on multi criteria decision making method for cloud computing environment: TSABMCDMCCE

https://doi.org/10.1515/comp-2019-0016
Received Jan 15, 2019; accepted Aug 09, 2019

Abstract: This Paper focuses on multi-criteria decision making techniques (MCDMs), especially analytical networking process (ANP) algorithm to design a model in order to minimize the task scheduling cost during implementation using a queuing model in a cloud environment and also deals with minimization of the waiting time of the task. The simulated results of the algorithm give better outcomes as compared to other existing algorithms by 15 percent.

Keywords: MCDM, ANP, Queuing model, Task scheduling, Cloud Computing

1 Introduction

In the current scenario, cloud computing has remarkably shown its high significance in the growth of technology and science. In cloud computing, resources are provided to the users on the basis of "pay per use" demand. Then the resources are allocated and are visible to the users. In different model of clouds, different scheduling algorithm and different virtual mechanics (VM) allocation mechanisms are applied. It is very challenging for the service providers to provide the resources on the basis of the demand. So, management of resources is very important for the service provider of the cloud [1]. For improving the performance of the systems when the workload increases then better resource utilization is needed. The resource management process is completed by resource allocation, resource provisioning and resource management. The service provider of the cloud requires carrying out the users on demand request, depending on the service level agreement (SLA). Every data center (DC) is made up of several physical machines. On the basis of the users request in cloud computing several VM are created in a particular physical machine [2]. The request of the user depends on different parameter like deadline, gain of the cost, compensation rate, start time, execution time and VMs number [3]. In cloud computing, at an instant of time several numbers of applications are processed and several numbers of resources are allocated. Resource management mechanism allocates resources for different application. When the application gets completed the mechanism distributes the previous resources to a new application and thus the resources become limited. So, cloud service providers (CSP) optimize the resource mechanism [4] and are thereafter implemented. But also, resources are limited in memory, storage space, and capacity of central processing unit (CPU), input/output (I/O) devices, more data center (DC) and bandwidth. So, on pay per use demand basis, a particular amount of resource must be provided to the user. In this way, under and over resource utilization [5] is avoided. This resource utilization can be achieved by the better scheduling algorithm [6] in cloud computing. At any time users can send the request for resources to the cloud provider [7, 8] and it should be made to run the applications. So, in this situation Cloud Brokerage Service (CBS) performs the task of a mediator which makes it easier to find the best resources for the users. Broker can easily access the cloud service from the cloud service provider (CSP). The client can get the services easily through the broker and perform the applications in cloud platform. Broker first collects the data from the users, analyzes the information and then sends it to the CSP, which gives the platform and also billing to the service provided. Broker also gives information integration services throughout all the cloud component services. Brokers are there to help the user to track all activities like number of data cen-

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ters (DC). DCs are used for execution time of each and every request and waiting time calculation of every request. The request of the user can be scheduled by using the Analytic Network Process (ANP) [9] and to reduce the waiting time by using Queuing theory. Several open source software in cloud computing is used for the managing DC. CloudAnalyst is one of the popular software. Brokers are implementing these two methods which are easier for the user as well as the CSPs. The application of ANP one of the technique of Multi-Criterion Decision Making (MCDM) [10] getting popularity to chase best possibility out of many alternatives, some applications are cluster head (CH) selection, website based, cloud platform, channel distribution and so on. This paper includes an improved scheduling algorithm for minimization of waiting time of the task, measuring the task sequence and reduces the time for the completion of the task. Scheduling aims to maximize the utilization of the resources. The proposed work is mainly focused to solve the task scheduling issues with ANP in a cloud computing environment. ANP is used as a priority based on lease scheduling algorithm [11]. ANP is also used with backfilling for sensitive scheduling purpose [12]. The authors aim is to design a system model with a good scheduling algorithm for the maximization of resource utilization and waiting time as well as cost of system reduction purpose. Here, the authors used ANP with M/M/c/K queuing algorithm for task scheduling purpose.

The organization of the paper is as follows, in section 2, the task scheduling model in a cloud environment and designed system model, state diagram queuing model and system flow is discussed. In section 3, we have presented the numerical analysis. In sections 4 and 5 the resulting analyse were discussed with the proposed work's conclusion and future work.

2 Overview of work

This section provides an overview of the traditional task scheduling algorithms. In a cloud computing field one of the major problem is atask scheduling [13]. This process minimizes the waiting time. Sometimes task scheduling causes increase of the profit in a cloud environment. Various scheduling techniques focus on how to execute the task and reduce the execution time. In cloud computing various types of traditional scheduling algorithms exist only. However, these techniques are not best suited sometimes in cloud systems because nodes are heterogeneous in nature [14]. The traditional task scheduling algorithms which are applied in cloud computing are FCFS (First Come First Serve) algorithm [14], RR (Round Robin) [15–17], RASA (Resource Aware Scheduling Algorithm) [18], RSDC (Reliable Scheduling Distributed in Cloud Computing) [19], Extended Max-Min Scheduling [20], priority based scheduling [21] and Optimistic Differentiated Task Scheduling Algorithm [22]. Some scheduling method which are related to the cloud computing arediscussed below:

A non-preemptive flow scheduling [23]. Here, jobs are performed in different order through the machines. Johnson Sequencing Flow Shop scheduling is used to minimize the make-span and to get the optimal sequence. In computing utilities in cloud computing as providing IT services [24]. Here, authors taken care of two things one is user service control another one is computational capabilities. According to the SLA resources are allocated. Authors are also dealing with how the virtual machines (VMs) worked with task request. The new task scheduling algorithm was developed for a combination of FCFS and backfilling algorithm in a grid computing environment [25]. This algorithm improves the resource utilization and reduces the time response. Here, the authors are also considered the resource recycling concept when the task will be accomplished. Job scheduling method also used for resource utilization purposes [26]. Author considered non-preemptive priority with the M/G/1 queuing model. This paper optimizes the cost estimation of each job using load balancing method [27]. In the studt [28] many researcher focus on the queue length and waiting time of the task, using M/M/s queuing algorithm. A novel estimated model established a relationship between different sensor clouds (SCs) and buffer size of the input [29]. The authors analyzed the blocking probability, service probability and the average no. of tasks. The cloud in a virtual environment could be classified [30]. Under this cloud computing, consist of automatic resource provisioning, renewal request accounting, request scheduling etc. This virtualization is implemented by the broker. A queue based job scheduling algorithm [31]. This algorithm improved the waiting time, average response time. The AHP method also acts as a task scheduling method for resource allocation purposes in a cloud computing environment [32]. The rank of the comparison matrix considered as task allocation. A priority based efficient task scheduling algorithm is developed in a cloud computing environment [33]. Here, author also compared with FCFS and RR two traditional algorithms. The whole method was tested in CloudSim toolkit. The workflow scheduling and a cloud broker strategy have developed by using a sequence diagram [34]. Authors also discussed the procedures of scheduling can be able in cloud broker. A multi criteria based task scheduling algorithm also developed [35]. The authors considered the different criteria like execution time, cost, bandwidth, etc. For the optimal sequencing authors considered the Johnson scheduling and for waiting time minimization M/M/c/K queuing model are used [36]. Another task scheduling model is implemented which reduced the make span and decreased the overall cost [37]. Authors created a pricing model and compared with a traditional genetic algorithm (GA), PSO and FCFS. How resources are allocated when the new task will be arrived in cloud computing [38]. Here, authors minimized the cost and execution time in deadline workflow scheduling. The Lion optimization based new task scheduling algorithm was developed to minimize the waiting time [39]. ANP method is also used to optimize the task scheduling [40]. Here in this process, they avoid the additional iteration due the changes of user preference. Markov chain is used for resource utilization prediction purposes and particle swarm optimization (PSO) used for the load balancing purposes [41]. A deadline sensitive scheduling algorithm is also implemented [42]. Here, authors were reducing the task rejection ratio and increased the acceptance ratio. The modified RR (MRR) waiting time is minimized and it has some good features like to avoid starvation, fairness and suitable for load balancing [43, 44]. A smarter RR scheduling model improved the resource utilization [45].

Table 1 shows the overall summary of traditional work.

3 Task scheduling modeling in cloud computing

In cloud computing various types of specific tasks of users are requested. The traditional queuing model is used for getting the optimal sequence of the scheduled tasks and also used for reducing the average waiting time of the tasks [46]. The objective of the work is to use ANP algorithm to design the system model and the service cost will be minimized by implementing the queuing model in a cloud environment. We assume that a batch containing of a fixed number of tasks because it is easy to calculate the service time from the Grant chart for every task. Then next is to reduce the customer number in queue and the system we have used is M/M/c/K queuing model and have also reduced the average waiting time in the queue and the system.

3.1 System model design

System model design is illustrated in this section by using a schematic diagram. This diagram deals with queuing model and scheduling phase. For the scheduling phase, we have considered the ANP algorithm to optimize the task sequence. M/M/c/K model is used for queuing system to find the individual waiting times.

Figure 1 shows our system design model, where number of customers created the request to the broker and requests must be storage based, resource based, platform based or infrastructure based and software based. The broker acts as an intermediate service, and its capabilities are identified after which access management is done. After the customer-access authorization, accordingly SLA service and user information are reported to the service provider. From the users, monitor module collects all resource data and task for the fixed time span. The available resources are determined by the analyzer module. The resources are sending the request if it is available, then accordingly SLA service is provisioned of the resources. Then accordingly ANP algorithm scheduler module schedules the task, which gets the optimal sequence of the scheduled tasks and also used for reducing the average waiting time of the tasks. These tasks are passing through the M/M/c/K queuing method which will be discussed later. In this way system sharing is maximized by efficiently service usage and cost, complexity is minimized by computational resources and also waiting time will be reduced.

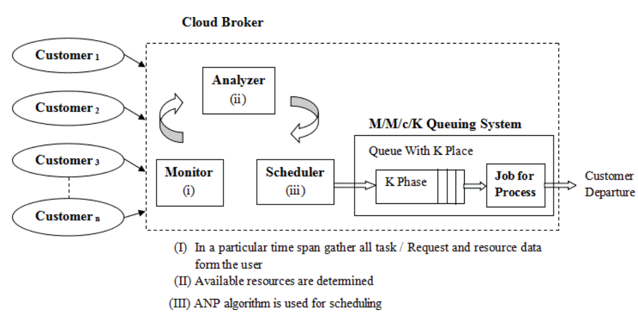

Figure 1: A scenario of cloud broker system design model

3.2 System flow

The system flow is mainly concerned with ANP algorithm with queuing models and multiple SCs with finite capacity. The ANP algorithm is taken under following consideration [47]:

1st consideration: In sequential manner two SCs (SC_1 and

Table 1: Summary of the review

Authors	Addressed problem	Work contributions
Cepek, O. et al. (2002)	Non-pre emptive shop scheduling	Johnson algorithm used to minimize the make span
Buyya R. et al. (2008)	VM is working for task request	Mainly focused on two things one is user service control another one is computational capabilities
Ni and Jiang (2009)	Resource recycling in task scheduling in grid computing	FCFS algorithm and backfilling methods are combined to reduce the response time
Li L. (2009)	Job scheduling for resource allocation	M/G/1 modeled used to minimize the cost
Fang Y., Wang F. and Ge J. (2010)	Load balancing the resource utilization	Resource utilization improved and fulfilled the client requirement
Sowjanya T. S. et al. (2011)	Sequencing the task queue length	M/M/s queuing algorithm is used for reducing the queue length and waiting time
Khazaaei H. et al. (2012)	Request response time distribution model	Developed an estimated model and analyzed the blocking probability, service probability and the average no. of tasks
Pal S., et al. (2013)	Different classification of virtual environment in cloud	Under this cloud computing, consist of automatic resource provisioning, renewal request accounting, request scheduling etc...This virtualization is implemented by the broker.
Behzard S., Fotohi R. and Effatpravar M. (2013)	Priority based scheduling procedure	Improved the average waiting times and response time and developed a queue based scheduling algorithm
Ergu D., Kou G., Peng Y., Shi Y., and Shi Y. (2014)	Resource allocation of the task	AHP method considered as a task scheduling method.
Agarwal A. and Jain S. (2014)	Resource allocation and utilization in a cloud computing environment	Generalized priority efficient task scheduling algorithm developed. Compared with two traditional algorithms FCFC and RR.
Pal S. and P. K. Pattnaik (2015)	Cloud broker scheduling procedure	Cloud broker sequencing diagram strategy
Lakra V. A. and Yadav K. D. (2015)	Most of the scheduling algorithm in single criteria	Considered the multi criteria like execution time, cost, bandwidth of the user etc. the CloudSim simulator had been considered for simulation
Pal S. and P. K. Pattnaik (2016)	Job scheduling in multi server model	Johnson and queuing algorithm is used to optimize the sequence and reduced the waiting time
Ibrahim E., El-Bahnasawy N. A.and Omara F. A. (2016)	Running task cost in a cloud computing environment	Developed a pricing model and decreased the task execution cost and make span
Patel (2017)	Load balancing in a dynamic cloud computing environment	HUA algorithm is used for load balancing which reduces the cost of the migration
Almezeini N. and Hafez A. (2017)	Execution time of the scheduling	Lion based optimized based task scheduling technique developed and minimized the execution time
Kunlun LI and Wang J. (2017)	To avoid the additional iterations due to the changes of client preferences	ANP method used as scheduling method
Swagatika et al. (2018)	Resource allocation in dynamic cloud computing environment	PSO and Markov chain is used for resource allocation when VM is migrating
Nayak S. C., et al. (2018)	Deadline scheduling in cloud environment	Acceptance of lease ration is increased and reduced the rejection lease to improve the scheduling
Khurma A. R., Harahsheh Al H. and Sharieh A. (2018)	Traditional Rounds Robin waiting time is long and server may be overloaded	Modified Rounds Robin (MRR) algorithm has been developed and it is tested in cloudSim toolkit and reduced the waiting time
Malik H. B., Amir M., Mazhar B., Ali S., Jalil R. and Khalid J.(2018)	Based on parameter scheduling technique discussed	Discussed the different task scheduling algorithm
Tani G. H. and Amrani El C.(2018)	Resource allocation in cloud computing, big data platform	Developed a power efficient scheduling model

Table 2: Processing Value

Task	SC1 Processing Time	SC2 Processing Time
1	T11	T12
2	T21	T22
3	T31	T32
4	T41	T42
5	T51	T52
6	T61	T62
7	T71	T72
8	T81	T82
9	T91	T92
10	T101	T102

SC_2) are arranged for execution of N requests and tasks.
2nd Consideration: At a time only one task will be processed on SCs.
3rd Consideration: Once a task is started it must be ended once it is completed.
4th Consideration: If tasks are in ready state any one of the SCs can be picked up for task processing.
5th Consideration: One SC to another SC task transferring time will be negligible.

In our system flow, we have considered 10 tasks and each task processing time is shown in a matrix in Table 1. Time matrix dimension is $T_{[i][j]}$ where i and j both are positive integer and i maximum is 10 and maximum range of j is 2 in Table 2.

ANP algorithm is implemented after this matrix for the sequence optimization and then for getting the waiting line we have applied M/M/c/K queuing algorithm. Figure 2 shows the system model.

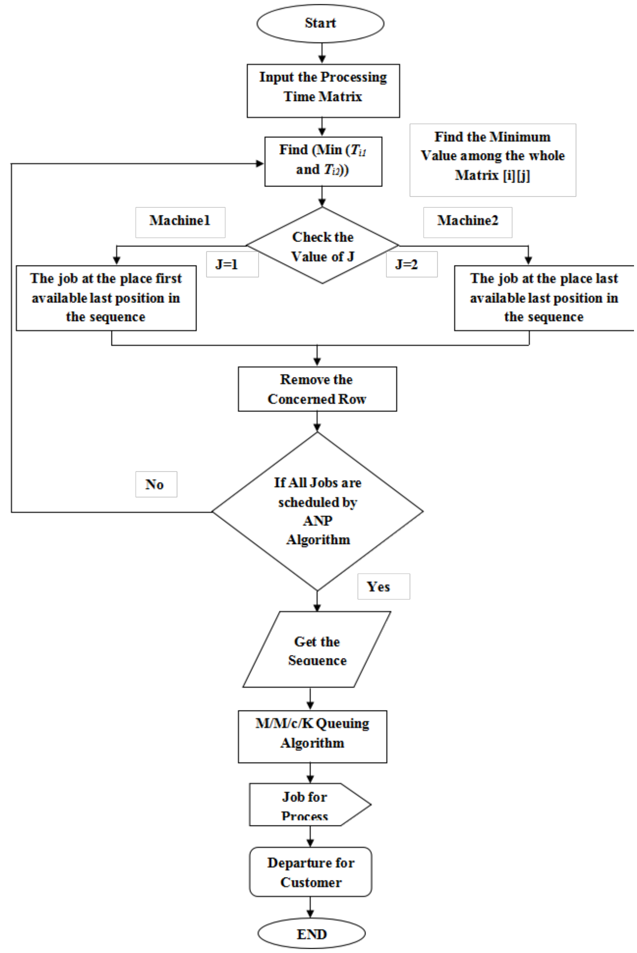

Figure 2: Flow of the system

4 Queuing model

Queuing model is implemented for the waiting line calculation purpose. The basic model is described by specifying the service process, arrival process and maximum capacity of the no. of places and services [48, 49]. Taking the assumption that Poisson distribution is used when the user request pass to the server, whereas exponential distribution is considered for processing time for every task. Also, considering the two SCs and waiting position have five places as capacity and a non-pre emptive system is developed with the M/M/c/K queuing model. In this paper, authors have merged the task scheduling [50] algorithm with queuing model. According to the Kendal's notation [51], in the case of Arrival Distribution (M), Inter-arrival times are Independent, Identically Distributed (IID) random variables with an exponential distribution. In service Distribution (M), service times are IID and are exponentially distributed [21].

For customer arrival pattern recognition Poisson distribution is considered. In this case λ is considered the rate parameter and τ considered as a time between successfull arrivals of the task. It means τ act as an inter arrival time and $E[\tau]$ is a mean [49]. So that average arrival rate λ is shown in equation 1.

$$\lambda = \frac{1}{E(\tau)} \tag{1}$$

The exponential distribution density *a(t)* the rate parameter is λ and t is the time when customers are arriving, so *a(t)* shown in equation 2 [21].

$$a(t) = \lambda e^{-\lambda t} \tag{2}$$

So the Poisson distribution can be written in equation 3 [47].

$$P(x) = \frac{\lambda^x e^{-\lambda}}{x!}, \quad \text{for } = 0, 1, 2 \ldots \tag{3}$$

Table 3: Weight allocation Table

Intensity of Weight Values	Definition	Explanation
1	Same situation for tasks	Two criteria contributed equally to formation task
3	Weakly suitable for tasks	Criteria slightly suitable one SC over another SC
5	Strongly suitable for tasks	Criteria Strongly suitable one SC over SC
7	Conform for tasks	A criteria are giving evidence with good cooperation in the election of the task
9	Not suitable for tasks	The criteria favoring one SC over SC are of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between the two criteria	When task chosen comparison is needed
Reciprocals of above nonzero	If activity i has one of the above nonzero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i	

Where $P(x)$ is an arrival probability and x is a time unit arrival.

Service time is the time elapsed between the start of the service to its completion. In case of service process, the authors have assumed that Service times are IID and are exponentially distributed. The service time of ith customer is considered,so the average or mean service time is denoted by $E(i)$,is shown in equation 4 [48].

$$E(S) = \frac{\sum_{i=0}^{n} S_i}{n} \tag{4}$$

Where n is no.of tasks and rate is μ shown in equation 5.

$$\rho = \frac{\lambda}{\mu} \leq 1 \tag{5}$$

System equilibrium condition is shown in equation 5.

5 Numerical analysis

In the proposed work, the authors have considered ANP as a scheduling method to handle the problem which will be discussed. It is very simple, powerful tool for calculating the rank among the criteria [52]. It also acts to reduce human resource allocation problem [53]. The ANP model structure is hierarchical; there is a relationship between goals, criteria (objective), sub-criteria (sub-objective) and the alternatives [54]. Then calculate the rank from pairwise comparison matrix [55] from the basis of the criteria.

So, we consider four criteria these are deadline (bottom line), the gain of the cost and reparation duty or compensation rate and start time. The task scheduling deadline represents the bottom line of scheduling. Every task has its own deadline. At a particular time the work has to be finished and if it is not completed, then compensation rate is involved. If the task is completed before the deadline, then the profit is maximized. Using Saaty 10 point relative scale [48] calculating the comparison matrix and calculating the rank of the matrix. The weight allocation table shows in the Table 3.

In equation 6. The goal is the best scheduling in the task. The comparison matrix where T is a table matrix where n task of resources k and $T_k$will be a matrix. The deadline is represented as D, cost gain as C and compensation rate as R and start time as S. Take an example, the compensation rate is more important than the deadline and lastly is gain of cost then the comparison matrix is

$$T_k = \begin{matrix} a_1 \\ a_2 \\ a_3 \\ . \\ . \\ a_n \end{matrix} \begin{pmatrix} C_1 & C_2 & C_3 & C_4 \\ v_{1,1} & v_{1,2} & v_{1,3} & v_{1,4} \\ v_{2,1} & v_{2,2} & v_{2,3} & v_{2,4} \\ v_{3,1} & v_{3,2} & v_{3,3} & v_{3,4} \\ . & . & . & . \\ . & . & . & . \\ v_{n+1,1} & v_{n+1,2} & v_{n+1,3} & v_{n+1,4} \end{pmatrix} \tag{6}$$

After updating MCDM technique, it is used to evaluate the rank, index and distribute it to all neighbor nodes through hello packets. The rank index will be calculated using ANP. Also, the Consistency Ratio (CR) is calculated.

First the Inner dependency matrix of the job scheduling factor is calculated with respect to the deadline, cost gain, compensation rate and start time. The equation 7 to 10 shows the matrix and CR.

$$\begin{matrix} C \\ R \\ S \end{matrix} \begin{pmatrix} C & R & S & Priority \\ 1 & 2 & 3 & 0.571 \\ 1/2 & 1 & 2 & 0.286 \\ 1/4 & 1/2 & 1 & 0.143 \end{pmatrix} \tag{7}$$

$CR = 0$

$$\begin{matrix} D \\ R \\ S \end{matrix} \begin{pmatrix} D & R & S & Priority \\ 1 & 6 & 7 & 0.758 \\ 1/6 & 1 & 2 & 0.151 \\ 1/7 & 1/2 & 1 & 0.091 \end{pmatrix} \tag{8}$$

$CR = 0.03$

$$\begin{matrix} D \\ C \\ S \end{matrix} \begin{pmatrix} D & C & S & Priority \\ 1 & 1 & 4 & 0.415 \\ 1 & 1 & 7 & 0.5 \\ 1/4 & 1/7 & 1 & 0.086 \end{pmatrix} \tag{9}$$

$CR = 0.03$

$$\begin{matrix} D \\ C \\ R \end{matrix} \begin{pmatrix} D & C & R & Priority \\ 1 & 4 & 3 & 0.63 \\ 1/4 & 1 & 2 & 0.218 \\ 1/3 & 1/2 & 1 & 0.151 \end{pmatrix} \tag{10}$$

$CR = 0.1$

After that the inner dependency matrix of task scheduling for all criteria are shown in equation 11.

$$\begin{matrix} D \\ C \\ R \\ S \end{matrix} \begin{pmatrix} D & C & R & S \\ 1 & 0.758 & 0.415 & 0.63 \\ 0.571 & 1 & 2 & 0.218 \\ 0.286 & 0.151 & 1 & 0.151 \\ 0.143 & 0.091 & 0.086 & 1 \end{pmatrix} \tag{11}$$

After this calculated the Normalized weighted supper matrix in the equation 12.

$$\begin{matrix} D \\ C \\ R \\ S \end{matrix} \begin{pmatrix} D & C & R & S \\ 0 & 0.758 & 0.415 & 0.63 \\ 0.125 & 0 & 0.671 & 0.218 \\ 0.490 & 0.151 & 0 & 0.152 \\ 0.425 & 0.191 & 0.086 & 0 \end{pmatrix} \tag{12}$$

For the calculation we considered five alternatives VM. So priority of five alternatives VM based task scheduling matrix shows in equation 13.

$$\begin{matrix} VM_1 \\ VM_2 \\ VM_3 \\ VM_4 \\ VM_5 \end{matrix} \begin{pmatrix} VM_1 & VM_2 & VM_3 & VM_4 & VM_5 & Priority \\ 1 & 3 & 5 & 5 & 9 & 0.458 \\ 1/3 & 1 & 4 & 6 & 7 & 0.271 \\ 1/5 & 1/4 & 1 & 1 & 6 & 0.166 \\ 1/5 & 1/6 & 1 & 1 & 4 & 0.055 \\ 1/9 & 1/7 & 1/6 & 1/4 & 1 & 0.023 \end{pmatrix} \tag{13}$$

Next we also calculated the weighted matrix of alternative to find the best strategy in equation 14.

$$\begin{pmatrix} Alternatives & Weight \\ VM_1 & 0.485 \\ VM_2 & 0.264 \\ VM_3 & 0.165 \\ VM_4 & 0.054 \\ VM_5 & 0.034 \end{pmatrix} \tag{14}$$

In this way we have considered the highest rank of VM allocation for the scheduling the task.

6 Simulation environment

6.1 Parameters

We assumed that there is no priority constraint between the task and not preventive task. They could not interrupt the different processor when the execution running.

In Table 4, we considered heterogeneous 100 physical nodes and 20 DC. Each node has their own operating system either Windows or Linux and 10 VM, one core CPU each. 4 GB RAM and 1 TB storage and CPU performance are equal to 1k or 2k MIPS. Every VM performs the different application and the central processor is uniformly distributed. The experiment has been executed for 60minutes.

Table 4: Simulation Parameter

Parameter	Value
Data Center	20
Number of Nodes	100
Virtual Machine	10
CPU Speed	1k or 2kMIPS
Storage	1TB
RAM	4DB

6.2 Results analysis

Cloud Analyst is able to simulate the proposed model with consideration of above different parameter very easily. We have considered different task scheduling algorithm like RR, Equally Spread Current Execution (ESCE), Throttled, and AHP with queuing algorithm and Proposed ANP. In Figure 3, shows the CloudAnalyst simulation environment.

Table 5: Overall Response Time Summary

Load Balancing Algorithms	Overall Response Time		
	Avg. (ms)	Min (ms)	Max (ms)
RR With Closest Data Center	50.37	37.76	61.26
RR With Optimize Response Time	50.38	37.96	62.52
RR With Reconfigure Dynamically	53.25	37.65	76.11
ESCE With Closest Data Center	50.11	37.61	61.06
ESCE With Optimize Response Time	50.38	37.96	62.52
ESCE With Reconfigure Dynamically	51.04	37.65	62.46
Throttled With Closest Data Center	50.41	37.61	61.06
Throttled With Optimize Response Time	50.38	37.96	62.52
Throttled With Reconfigure Dynamically	51.03	37.65	62.41
AHP With Closest Data Center	50.11	37.61	61.29
AHP With Optimize Response Time	50.38	37.96	62.52
AHP With Reconfigure Dynamically	50.97	37.65	62.41
ANP With Closest Data Center	50.21	37.61	61.12
ANP With Optimize Response Time	50.18	37.74	62.27
ANP With Reconfigure Dynamically	51.03	37.65	62.41

Figure 3: Simulation environment in Cloud Analyst with data center [56]

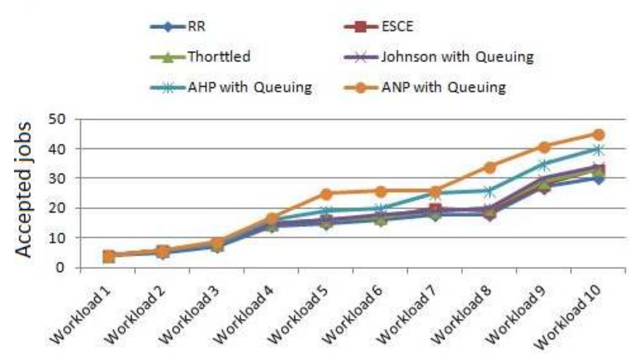

Figure 4: Comparison of completed task in queue in system with respect to the workload

The five different task scheduling policies simulated one by one and calculated the response time, processing time of the request and cost and give the results in a tabular format. In this figure five DC and UB are placed in different region. Here, total region is six and each region have an individual region ID or cloud ID. North America ID is 0, South America ID is 1, Europe is 2, Asia 3, and Africa is 4 and Oceania 5. Here, every region has different users, simulations peak time, duration, bandwidth, latency also different. In this figure UB and DC are placed in 0, 1, 2, 3 and 4 region and show the individual region maximum, minimum and average processing time.

From Table 5, 6 and 7, it is surmised that the ANP task scheduling algorithm gives the best data center processing time, response time with low processing cost than RR, ESCE Throttled algorithm and AHP. Different broker policies CDC is the best when requests are forwarded to the CDC and get in lesser time response.

After the simulation on Cloud Analyst proposed work also implemented in MATLAB for waiting time and VM utilization and wastage of VM calculation purposes. For this simulation we considered the 10 VM and 10 workloads.

Figure 4 shows the number of the tasks in queue, which we compare with the proposed work and traditional work. In the proposed work more number of tasks are completed in queue than the other traditional work. In this picture workload 1, 2, 3 and 4 are same in all algorithm including the proposed work. After the workload 4, job acceptance number is higher in the proposed work.

Similarly, waiting time of the system can be calculated in the Figure 5 and compared with a proposed method

Table 6: Data Center Processing Times

Load Balancing Algorithms	Processing Time of Data Center		
	Avg. (ms)	Min (ms)	Max(ms)
RR With Closest Data Center	0.75	0.03	1.27
RR With Optimize Response Time	0.79	0.01	1.28
RR With Reconfigure Dynamically	3.63	0.02	18.88
ESCE With Closest Data Center	0.49	0.02	0.90
ESCE With Optimize Response Time	0.79	0.01	1.28
ESCE With Reconfigure Dynamically	1.42	0.02	4.49
Throttled With Closest Data Center	0.79	0.02	0.90
Throttled With Optimize Response Time	0.79	0.01	1.28
Throttled With Reconfigure Dynamically	1.41	0.02	2.68
AHP With Closest Data Center	0.49	0.02	1.27
AHP With Optimize Response Time	0.79	0.01	1.28
AHP With Reconfigure Dynamically	1.35	0.02	4.45
ANP With Closest Data Center	0.59	0.02	1.02
ANP With Optimize Response Time	0.59	0.01	62.27
ANP With Reconfigure Dynamically	1.41	0.02	4.45

Table 7: Overall Processing Cost

Load Balancing Algorithms	Processing Cost		
	Total VM Cost	Total DC Cost	Grand Total
RR With Closest Data Center	10.54	0.38	10.92
RR With Optimize Response Time	10.54	0.38	10.92
RR With Reconfigure Dynamically	26.35	0.38	26.73
ESCE With Closest Data Center	3.01	0.38	3.40
ESCE With Optimize Response Time	10.54	0.38	10.92
ESCE With Reconfigure Dynamically	26.26	0.38	26.64
Throttled With Closest Data Center	10.54	0.38	3.40
Throttled With Optimize Response Time	10.54	0.38	10.92
Throttled With Reconfigure Dynamically	26.16	0.38	26.55
AHP With Closest Data Center	3.01	0.38	10.92
AHP With Optimize Response Time	10.54	0.38	10.92
AHP With Reconfigure Dynamically	26.16	0.38	26.54
ANP With Closest Data Center	5.52	0.38	5.90
ANP With Optimize Response Time	5.52	0.38	5.90
ANP With Reconfigure Dynamically	21.25	0.38	21.64

with existing methods. In this picture shows that in the proposed work waiting time is reduced with respect to the workload increment.

In Figure 6 and 7 shows the comparison done with the existing algorithms and propose work for VM slot utilization and VM slot wastage respectively. In Figure 6 shows that, in the proposed algorithm utilization of VM slot is increased with respect to the workload increment. But in Figure 7 shows the wastage of the VM slots are decreased with respect to the workload increment in the proposed work.

The proposed mechanism shows that the allotted VM slots are closed to the VM available slots and the traditional approach is above which is shown in Figure 6. In proposed method more tasks are scheduled than the other traditional work. Similarly, in Figure 7 shows the VM slots wastage than the proposed algorithm. So, the resource allocation is more in the proposed mechanism. The percentage of VM utilization and VM wastage are shown in Figure 8 and 9 respectively. In the proposed work utilization of resources is better than the traditional works in all work-

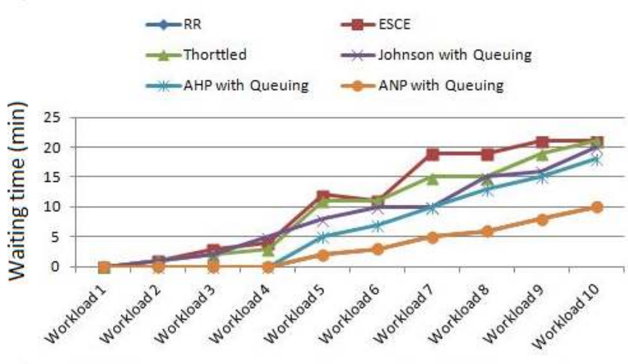

Figure 5: Comparison of waiting time of the task in the system

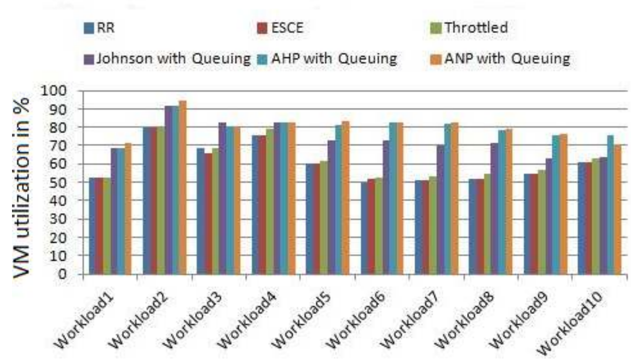

Figure 8: Comparison of VM slot utilization

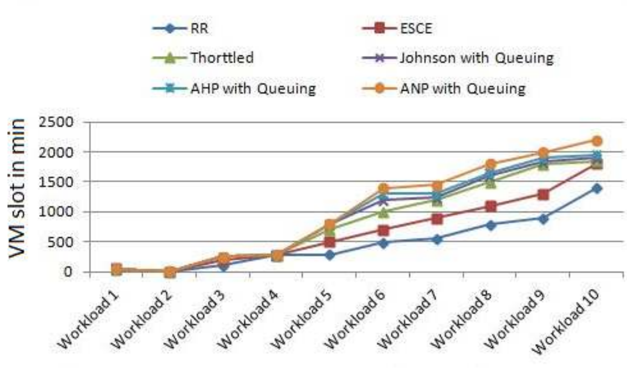

Figure 6: VM slots utilization

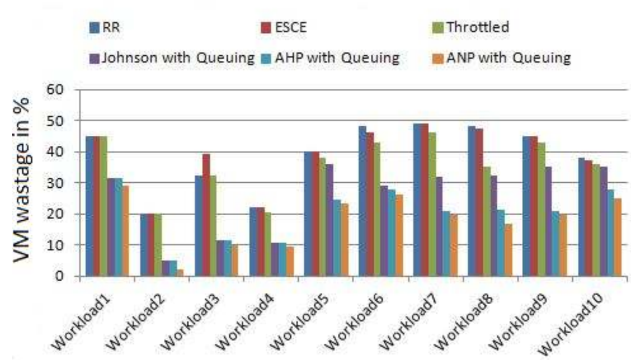

Figure 9: Comparison of VM slots wastage

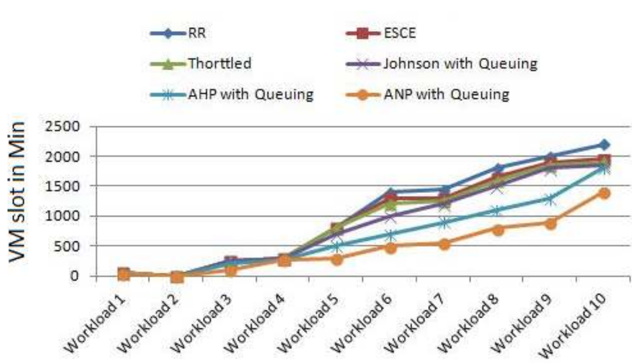

Figure 7: VM slots wastage

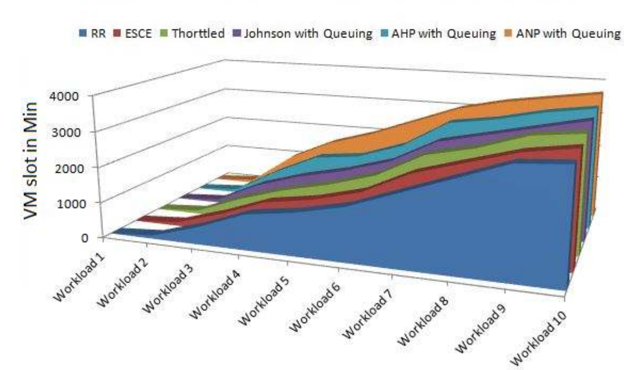

Figure 10: Comparison of VM slot utilization for different workloads

loads and the comparison of the result in shows in Figure 8. In Figure 9 shows that the resource wastage percentage is less in the proposed work.

Figure 10, shows the different workload, how the VM utilization varies for different specifications due to the average completed task ratio in the proposed work as compared to the traditional mechanisms.

The proposed work is better in scheduling of tasks and utilization of resource than traditional mechanisms as shown in Figure 8, 9, and 10.

The Figure 11 and 12 shows the overall time response and DC processing time of the system respectively. The proposed algorithm in both picture shows that minimum times to take for completion of task. That means, the waiting time of the task is minimized in proposed ANP queuing scheduling algorithm than the other traditional algorithms.

In the Figure 13 shows the overall processing cost of the system. Here shows that in ANP queuing algorithm pro-

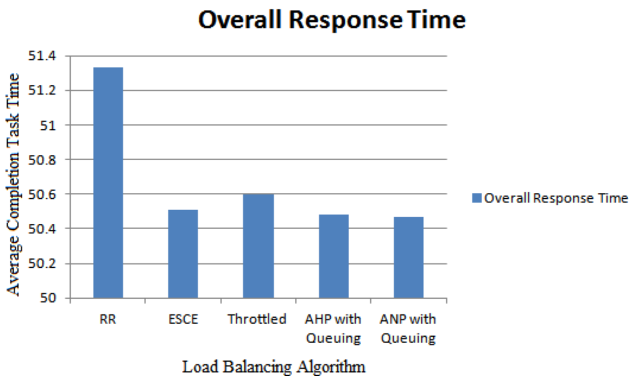

Figure 11: Overall time response of the system

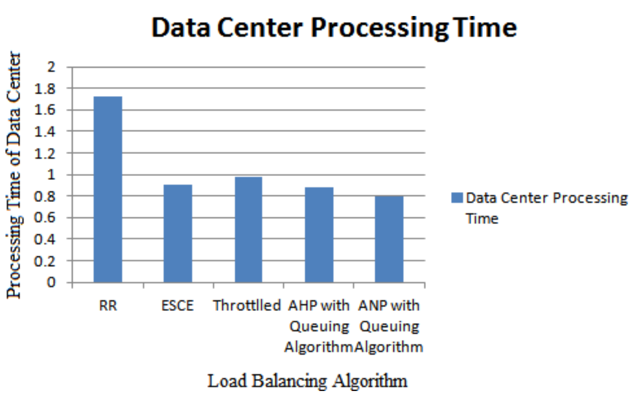

Figure 12: Data Center processing time of the system

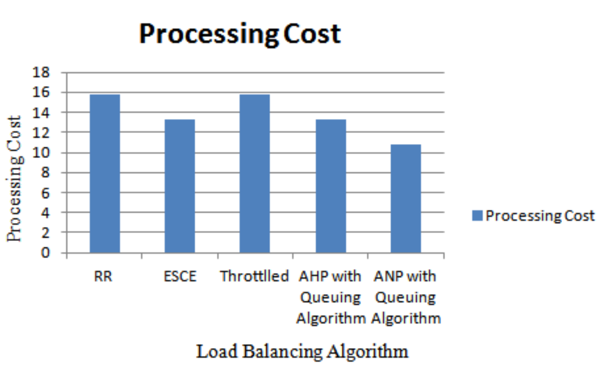

Figure 13: Processing cost of the system

cessing cost is much lesser than the other scheduling algorithms.

So, the aim of this paper is to minimize the waiting time of the task and also minimized the overall cost of the system. Here, CloudAnalyst and MATLAB software simulation software shows the ANP queuing algorithm is more efficient implemented scheduling algorithm than the other four i.e., RR, ESCE, Throttled and AHP Queuing Algorithms.

7 Conclusion

In research and academic area cloud computing plays a very important role in recent days. Brokers used virtual resources and allocate them on the basis of requirement. Here, we discussed the scheduling and queuing algorithm for finite capacity and multi server. This paper, implemented ANP and queuing model, so it gives 15% better outcomes from the other traditional model. This article ANP method is used for measuring the optimal sequence length and the queue length and waiting time is reduced by M/M/c/K queuing algorithm. It is shown the comparative study. The method is represented taking into consideration the priority basis, scheduling and have also considered the deadline scheduling in the future.

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