RESEARCH ARTICLE OPEN ACCESS

# A Survey of Load Balancing Algorithms in Cloud Computing

Sumandeep Kour Raina, Sarpreet Singh
Department of Computer Science,
Sri Guru Granth Sahib World University, Fatehgarh Sahib
India

**ABSTRACT**
Cloud computing is rising technology which is a new ordinary of large scale distributed computing. Cloud Computing associates to both the applications delivered as a service and datacenters, where hardware& software existing to provide service to customers through internet. A Cloud Computing is growing rapidly and more users are attracted towards a fast service needs to provided. The Load can be memory network or delay load. It always make necessary share work load among various nodes of the distributed system to improve the resource utilization, maximum throughput, and maximum response time and for better performance of the system. Here in this paper we have study many different Load Balancing Algorithms in Cloud Computing.
***Keywords*:-** Cloud Computing; Load Balancing; Load Balancing Algorithms.

## I. INTRODUCTION

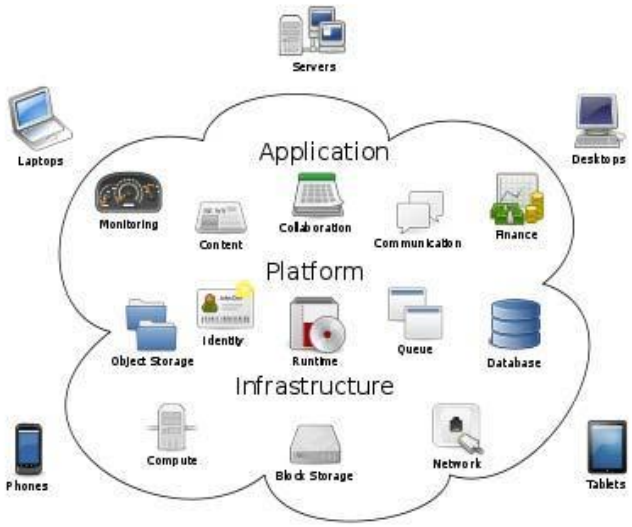
### 1.1. *Cloud Computing*

The term 'cloud' has ancient been used in the telecommunication industry as a a representation for authorize all over Convenient on-demand network access to shared pool arrangement of computing resources(example network server, storage applications and services) that can be immediately need and released with essential micromanagement effort or service provider communication.

Cloud Computing is a better advance technology which facilitate the organization or individuals to share different resources in a seamless and cost efficient manner [MuthLakshmi,(2013)] over the network on public ,/private networks . In Fig .1. shows that Cloud Computing associates to both the applications delivered as a service and datacenters, where hardware& software existing to provide service to customers through internet .The services themselves have long been associate to as software as a service (SaaS) , Data as a service (DaaS) is also called as a cloud. Cloud Computing is achieving a computing tasks via network connection at a same time remaining in inaccessible from the complex computing hardware and software infrastructure.

concept of the network in system [Yoganandani *et*

Fig. 1. Cloud Computing [ Patidar *et al*.,(2012) ].



### 1.2. *Evolution of Cloud Computing*

Cloud concepts have existed for many years whose only function *was to* provide access to the mainframe.Evolution of cloud computing started shows in Fig .2.started in the 1950s with mainframe computing. These machines can be connected [MuthLakshmi,( 2013)] by a high bandwidth network and managed by specific software tools that manage them as a single system or Cluster. A grid is a Cluster of servers where huge task could be divided into smaller tasks which run in parallel systems. Utility computing is a concept established by John Mc Carthy who forecast already in late 2000 Utility dispose computing was the first steps towards 'pay- per -use'. Utility of computing based on the idea of maintaining computing solutions as a utility like natural gas, water or power. The recent development of Software as a service "SaaS" was the beginning in 2005 of cloud computing in the real sense .It is an application that can be run from any place in the world as long as you have a computer with internet connection. Eg Gmail, Yahoo Mail etc.

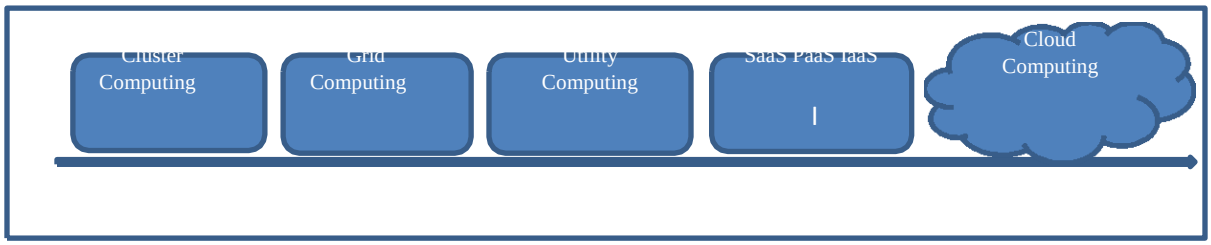



Fig .2. The Essential Characteristics of Cloud Computing[Yoganandani *et al*.,(2014)].

The various essential characteristcs of cloud computing is On-Demand Self Service,Broad Network Access ,Resource Pooling ,Rapid Elasticity, and Measured Service are shows in Fig.3.

- **On-Demand Self-Service** A user can utilize computing services Email, Applications resorting to human interaction with [Yoganandani *et al.*,(2014)] providers of these resources.
- **Broad Network Access** The computing resources are available over the network and accessed through standard mechanisms that promote use by heterogeneous thick or thin client platforms such as mobile phones, laptops situated at customer location.
- **Resource Pooling** A cloud computing resources are shared together to serve multiple customers using either multi tenancy.
- **Rapid Elasticity** Cloud computing separately from traditional datacenter .Multiple Occupants occur in a cloud environment that share components of a shared resource pool.
- **Measured Service** Metered services also referred to as "pay per use" in a mean of responsibility. Resources utilization is measured by check storage usage, CPU hours and bandwidth usage etc.

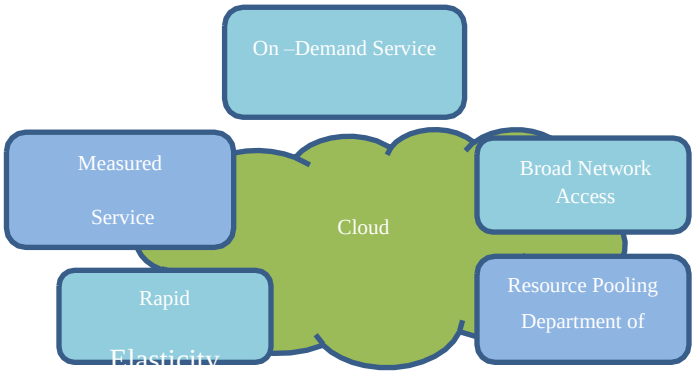



Fig . 3. Characteristics Cloud Computing [MuthLakshmi,( 2013)].

### 1.4. *Cloud Deployment Models*

The cloud computing mostly gets deployed on four deployment servers by which the users can access the services provided by clouds [MuthLakshmi,( 2013)].

- **Public Cloud Model** The Public Cloud Model allows systems and services to be easily accessible to public. Google, Amazon, Microsoft offers cloud services through internet are public cloud models. It may be owned, managed, and operated by a business, academic, or government organization or some combination of them also has several advantages which make the people to use easily. But few limitations also exist which are low security and Less customizable.
- **Private Cloud** In this private cloud model, it allows the systems and services to be accessible only by the people in the organization which means other than the people in the specified organization are not allowed to use access the services.
- **Community Cloud** It may be managed, operated and owned by one or more of the organizations in the community.
- **Hybrid Model** Is an environment which combines public clouds and private clouds by allowing data and applications to be shared between them.

### 1.5. *Service Models of Cloud*

In practice, cloud service can be grouped into three categories, software as a service (SaaS), Platform as a service (PaaS), and infrastructure as a service (IaaS). Shows in Fig.5. [MuthLakshmi,( 2013)].

- **SaaS (Software-as-a-Service)** In this model a software provider license a software application to be used and purchase on demand in multi-tenant environment, runs on web browser in client machine. Example Gmail and Salesforces.com.
- **PaaS (Platform-as-a-Service)** It offers a development platform for both completed and in progress cloud application offer an environment where developer can develop to create and deploy applications and do not need to know how much memory and processors their application requires. Example Google App Engine, Java, Ruby Language.
- **IaaS (Infrastructure-as-a-service)** IaaS service provider offer virtual server containing one or more CPU running several choices of operating (IaaS). Example Web Services offer IaaS.


Fig.5. Cloud Services [Puthal *et al.*,(2015)]

**1.6 .** ***Challenges in Cloud Computing***

- **Interoperability** The implementation on one [MuthLakshmi,( 2013)] platform should be able to include services from the other platforms.
- **Security and privacy** Security and privacy of information is the large problem to cloud computing. Security and Privacy issues can be control by high encryption, security hardware and security application.
- **Portability** This is another challenge to cloud computing that application should easily be migrated from one cloud provider to another. The must not be indulge-in however it is not still made possible because each of the cloud provider uses different standard communication for their platforms.
- **Computing Performance** Datacenter applications on cloud require high network bandwidth, which results in high cost, low bandwidth does not meet the desired computing performance of cloud application.
- **Reliability and Availability** It is necessary for cloud to be dependable and powerful because most of the businesses are now becoming dependent on services provided by third-party.

## II. LOAD BALANCING

**2.1.** ***Load Balancing***

Load balancing is one of the major issues in cloud computing. The load can be memory network or delay load. It always make necessary share work load among various nodes of the distributed system to improve the resource utilization, maximum throughput, and maximum response time and for better performance of the system. This can help to avoid the situation where nodes are either loaded or under loaded in the network. Load balancing is the process of ensuring the evenly distribution of work load on the pool of system node or processor so that the running task is completed. One of the best example related to load balancing are websites the goal of load balancing [Pathak,(2017)] [Megharaj,(2016)] are to.

- 

I m p r o v e t h e p e r f o r m a n c e .

- 

M a i n t a i n s y s t e m s t a b i l i t

y
.

- Construct fault tolerance system.

**There are basically two types of Load Balancing**

- **Static Load Balancing** In static algorithm the traffic is divided among the servers. This algorithm requires previous knowledge of system resources load does not depend on the present state of system. Static algorithm is proper in the system which has low dissimilarity in load [Pathak,(2017)].
- **Dynamic Load Balancing** In dynamic algorithm the lighted server in the entire network or system is searched and preferred for balancing a load .Here present state of the system is used to manage the load [Pathak(2017)]. This will overcome the drawback of static approach .The dynamic algorithms are complex, but they can provide better performance and fault tolerance**.**

**2.2.** ***Dynamic Load Balancing Policies***

Load balancing algorithms can be defined by their implementation of the following policies. [Kumar(2015)].

- **Information policy** Collection of information about the node in the system in load balancing algorithm.
- **Transfer policy:** Selection of a job in dynamic load balancing algorithm for transferring from local to remote node.
- **Location policy** It is used to find a partner for a server or receiver.
- **Selection policy** It specifies the processors involved in the load exchange.
- **Load estimation policy** Total amount of workload on processor**.**
- **Process Transfer policy** It is used to deciding which task is to be executed locally or remotely.

### 2.3. *Metrics for Load Balancing*

There are some qualitative metrics that can be improved for better load balancing in cloud computing [Pathak,(2017)].

- **Throughput** This metric are used to estimate the total number of tasks, whose execution has been completely successfully.
- **Overhead** This metric indicates the amount of overhead during implementing the load balancing algorithm. • **Fault Tolerance** Fault tolerance can perform uniform load balancing in case of any failure.
- **Migration Time** Migrating the jobs required the total time from one node to another.
- **Response Time** This metric are used to time out between sending a request and receiving its response.
- **Resource Utilization** It is used to assure the proper utilization of all those resources.
- **Performance** It is used to check how efficient the system is overall system performance can be improved.
- **Scalability** It is capability of load balancing algorithm for a system with any limited number of processor and machines.

### 2.4. *Challenges in Load Balancing*

Some of the common challenges that might be faced while developing a solution for a problem of load balancing in cloud computing. [Ravi *et al.*,(2015)].

- **Migration Time** While serving the client on hid demands sometimes we need to migrate resources for long distances. In such cases the time of migration of resources will be more affect the performance of the system.
- **Performance of the System** It does not means that if the complexity of an algorithm is high then the performance of the system will be high. Any time load balancing algorithm must be simple to implement and easy to operate.
- **Energy Management** A load balancing algorithm should be designed in a way such that the operational cost and the energy consumption of the algorithm must be low. Increase in the energy consumption is one of the main problems that cloud computing is facing today. So to achieve better results in energy management a load balancing algorithm should be designed.
- **Security** Security is one of the problems that cloud computing has in its top most priority. So an efficient load balancing algorithm must be strong enough to reduce the security attacks but should not be vulnerable.

## III. LOAD BALANCING ALGORITHMS

There are many algorithms are recognized and proven good for cloud load balancing, some are listed here [Nema *et al*.,(2016)].

**3.1.1. *Round Robin Algorithm*** This is a static load balancing algorithms which uses the round robin method for allocating work. It chooses the first node at undirected and then assigned job to all other nodes in a round robin manner [Nema *et al*.,(2016)].Even though the load is distributed equally it is not possible to foresee the execution time of a process. So this algorithm is not suitable for efficient load balancing. The response time can be improved. **3.1.2. *First Come First Service Algorithm*** This is a dynamic load balancing algorithm. FCFS algorithm is the simple scheduling algorithm where processes are dispatched as per their arrival time on the ready queue [Nema *et al*.(2016)].

The FCFS scheduling is sensible in the traditional sense it is excessive in the sense that long job build short job wait and insignificant jobs make significant job waits.

**3.1.3. *Min-Min Load Balancing Algorithm***

This is also a static load balancing algorithm it act with the jobs having minimum execution time by assigning them to the processors [Ravi *et al*.,(2015)].This algorithm accomplish better when the numbers of jobs having very small execution time is more than jobs having extremely large execution time . This algorithm leads to starvation**.**

**3.1.4. *Max-Min Algorithm Load Balancing***

This is a static algorithm in this Max-Min load balancing algorithm large tasks will be acquire

highest priority [Ravi *et al.*,(2015)].This algorithm the process begins with considerate the information about the execution time of all resources and then among all the resources a node with larger execution time will be selected.

**3.1.5.** ***Throttled Load balancing Algorithm*** In this algorithm end user first request the load balancer to check the availability of VM when the VM is set to be free the next job is assigned to it and is dynamic in nature [Ravi *et al.*,(2015)]. It helps in achieving better performance and high utilization of resources.

**3.1.6.** ***Ant Colony Optimization Algorithm*** Ant Colony Optimization algorithm simulates the ant foraging behavior. In this algorithm the behavior of ants is used for gathering information from different nodes in the system. When execution begin the ant and its [Ravi *et al.*,(2015)] pheromone will get proposed from the head node and moves to the next node .If the ant finds any of the nodes under loaded it will move forward to another node and if that node is overloaded it will come back to previous node .

**Working of ACO Algorithm**

- **Ant Generation** Analyze the cloud platform [Verma *et al.*,(2017)] if there are overloaded or under loaded nodes, only then ants are generated trying to minimize the makespan and maintain load across all the nodes with the given better results.
- **To find target node** The ant is looking for the target nodes with suitable condition of load balancing in its surrounding area.

**3.1.7.** ***Honeybee Foraging Algorithm*** This algorithm is inspired from the behavior of honeybees that uses the method to find and reap food from the sources. After they come back to honey comb and computes the food left, if there is enough amount of food they will halt in the comb in another way they will go out in search of more honey [Ravi *et al.*,(2015)][ Nema,(2016)] . In this algorithm resources are grouped as virtual resources. Each virtual resource maintains a process queue and accepts each request from the queue and processes those requests. That is why this algorithm is named as Honey bee foraging algorithm. Maintaining a separate queue for each node. In load balancing with increasing and decreasing web server's demands. This mechanisms in virtual server and load balancing is also useful while occupy the server for a process. Advantages are maximizing the throughput and overhead for system become minimum.

**3.1.8.** ***Genetic Algorithm*** This algorithm is used soft computing approach [Rajeshkannan and Aramudhan,(2016)] .This algorithm provides a better performance, compare to RR and FCFS algorithm. GA'S implementation mechanism is based on three steps.

- **Initialization Operator** Initial population is that the set of all population that are employed in the genetic algorithm.
- **Selection Operator** Best chromosome selects from the parents and produce offspring.
- **Crossover Operator** It combines two chromosomes that produce new chromosomes produce new offspring.
- **Mutation Operator** It Changes of one or more then gene value in a chromosomes. Or when blunt change in a given population chromosomes.

**3.1.9.** ***Particle Swarm Optimization Algorithm*** PSO is a swarm based heuristic optimization technique [Bansal and Kaur,(2016)]. It is used for analyzing optimal path of solution space while putting up load on a specific VM for processing of resources it moves along all the VM and determinate the optimal machine to put the load. It is one of the mechanisms to identify the optimal VM which is load less, and available .So the relative energy and time utilization to the node can be reduced.

**Basic Steps for PSO**

- Initialize population of particles with random position and velocities.
- Calculate the fitness function values for each and every particle.
- Compare the current particle's fitness value with each particle's fitness value and find Pbest value.

Table. 1. Comparison between various existing Load Balancing in Cloud Computing [Malani and Amdani,(2015)].

| S.No | Algorithms | Description | Advantages |
|---|---|---|---|
| 1 | Dynamic Round Robin Algorithm | Uses two rules to save the power consumption | Minimize the power consumption |
| 2 | Hybrid Algorithm | Combination of dynamic round robin and first-first algorithm | Better resource utilization, minimize power consumption |
| 3 | Min-Max Algorithm | Calculate minimum execution time and minimum completion time of task | Smaller Tasks are executed rapidly |
| 4 | Max-Min Algorithm | Same as Min-Min. Gives more priority to larger tasks than smaller ones | Larger tasks are executed quickly and efficiently |
| 5 | Ant Colony Optimization Algorithm | There are two types of movements: forward and backward | Detection of over loaded and under loaded nodes can be done |
| 6 | Honeybee Foraging Behavior Algorithm | Attains global load balancing towards local server actions | Increase Scalability |

## IV. LITERATURE REVIEW

- **Peenaz Pathak, Kamna Mahajan (2015)** Author describes that Genetic Algorithm in which a new approach Pollination Based Optimization (PBO) is used to optimize the results of GA (Genetic Algorithm). The performance of these two algorithms are compared that will prove the effectiveness of the optimization methods. On the basis of results calculated it have been proved PBO find best solution for the problem of scheduling and load balancing in cloud computing environment .It is better than GA if system response time not only reduces the response time but also makespan .Optimization Algorithm can be applied and compared to minimize the total job completion time and to enhance system performance.[Pathak and Mahajan, (2015)].
- **G.Patel et al. (2015)** Author shows that a study variety of task scheduling algorithm and modification of load balanced Min-Min (ELBMM) Algorithm for static Meta-Task Scheduling. Enhanced Load balanced Min-Min Algorithm (ELBMM) based on Min-Min strategy to produce better makespan and utilize resource effectively. Theoretical analysis and Result analysis of LBMM and ELBMM shows that ELBMM produce better makespan and utilize resource as compared to LBMM [ Patel *et al.*,(2015)].
- **Mohit Kumar, S.C.Sharma (2017)** Author shows that there a number of load balancing algorithms and techniques proposed by researchers aim is to distribute the workload among all the VM. We developed a load balancing algorithm that minimize makespan time and enhance the utilization of cloud resources and compare Min-Min Algorithm, First Come First Service and Shortest Job first Algorithm. Experimental results shows proposed algorithm reduces the makespan time and increase the average resource utilization [ Kumar and Sharma,(2017) ].
- **S.MubarakT et al. (2017)** Author presents that a algorithm a combination of Ant Colony Algorithm and Artificial Bee Colony Algorithm will improve the existing AB Algorithm and provide a better optimal solution for effective load balancing and decrease the load in the system, providing a good flow of work for the system. Advantages of this proposed algorithm are maximum throughput, reduction in overloaded of servers [MubarakT et al., (2017)].
- **Anju Baby (2014)** Author describes a HBB load balancing model is not assign task to proper VM and also not examine the QOS. In order they can overcome the drawback of Honey Bee Algorithm and another one used is PSO Algorithm. This proposed algorithm check all the VM and assign the task to proper VM which have least memory loss and optimized the

minimum task completion and task response time. The proposed algorithm overcome disadvantages of honey bee inspired algorithm is it select tasks in first come first order not analysis of all the free VM [Baby,(2014)] .

- **Shanti Swaroop Moharana et al. (2013)** Author showed that the cloud computing is a new technology which uses VM replacement of Physical machine to host the different components. Load balancer are used for assigning load to different VM along none of the nodes get loaded heavily or lightly overloaded of system lead to poor performance but our focus is on various load balancing algorithms and applications
- **Hussain A Makasarwala, Prasun Hazari (2016)** The author shows the load balancing is one of the major issues in cloud computing. But this paper gives a Genetic Algorithm approach for load balancing in cloud. The idea behind in considered the priority is to get real world virtualization. Simulation of the proposed method is done using Cloud Analyst. It will give better response time compared to previous available methods [Makasarwala and Hazari,(2016) ].
- **Y. Kaushik et al. (2015)** Author presents an enhanced algorithm through compression various cloud load balancing algorithms. This paper shows the comparison of various load balancing algorithms like Round Robin, Equally Spread Current Execution load balancing and Throttled in cloud with different metric like Response time. Throttled Algorithm allocates the resources to the job in queue leading reduced cost in data transfer and VM machine formation [Kaushik *et al.*(2015)].
- **Maysoon A.Alamin et al. (2017)** In this author presents the challenging problems that affect the load balancing process is scheduling incoming request in an efficient way with minimum response time .The new load balancing proposed algorithm handle the load balancing problem in cloud computing .This proposed algorithm combine the Throttled and Equally Spread Current Execution algorithm results showed the proposed algorithms improve the cloud system performance by decreasing the response time and cost [Alamin(2017)].
- **Subasish Mohapatra et al. (2013)** This shows different load balancing algorithms in order to manage the resources of services provider efficiently and effectively. This paper presents a comparison of various policies utilized for load balancing. Future work based on this modified algorithm better response time can be expected if we apply some evolutionary algorithms such as PSO, ACO instead of different scheduling algorithms [Mohapatra et al. ,(2013)].
- **Tran Cong Hung, Nguyen Xuan Phi (2016)** Author presents that more effective methods of load balancing, in order to increase system performance. Therefore in this paper we researched some parameters affecting the performance load balancing on the cloud computing and reduce the time makespan of VM [ Hung and Phi,(2016)]. • **Navtej Singh Ghumman, Rajesh Sachdeva (2016)** Author describes an effective and efficient and enhanced composite scheduling algorithm that can be used to maintain the load and provides efficient resource allocation techniques. In these paper composite approaches is applied for load balancing using Throttled Algorithm and Equally Spread Current Execution (ESCE) Algorithm and take less response time and average time to achieve the objective [Ghumman and Sachdeva,(2016)].

cloud computing environment [ Mo

- **Kousik Dasgupta et.al (2013)** Author describes a new load balancing strategy using Genetic Algorithm (GA).This algorithm to balance the load of the cloud infrastructure while trying minimizing the completion time of a given task set. Load balancing action has been simulated using the Cloud Analyst Simulator. GA has been used however variation of the crossover and selection strategy could be applied as a future work for getting more better results. PBO is better than GA if system response time is not considered not only reduce the response time but also minimize makespan and enhance system performance[Dasgupta et al.,(2013)] .

## V. CONCLUSION

Load Balancing is one of the main issue in cloud computing. Main purpose of load

balancing is to distribute load among various individual servers. In this paper, various techniques related to efficient Load Balancing are analyzed and compared to the other techniques. And we have also discussed required qualitative metrics for load balancing. In future work the soft computing hybrid techniques may increase the performance of the system and to meet the requirements of load balancing in cloud computing.

## VI. FUTURE SCOPE

In future work, we are planning to optimize PSO algorithm to make it appropriate for cloud computing and more efficient in terms of load balancing. In addition to this, the optimization of PSO on various cloud simulators and compare the proposed approach with previously soft computing techniques based on fixed parameters. It may increase the performance of the system and to meet the requirements of load balancing in cloud computing.

## REFERENCES


[1] oganandani ,et al. (2014): Clearing The Clouds On Cloud Computing. International Journal of Recent Development in Engineering and Technology. **1**(1), pp. 117-118.

[2] MuthLakshmi .V.N. (2013) .Cloud Computing-An Overview. Publication of Problems &Application in Engineering Research, **4**(1), pp.324-325.

[3] Pathak. R. (2017): A Survey of Load Balancing in Cloud Computing Challenges and Algorithms. International Journal of Innovative Research in Computer and Communication Engineering, **5**(1), pp.740-742.

[4] Mishra.G; G Mohan K .(2016):Load Balancing Techniques in Cloud Computing. International journal of Computer Engineering, **18**( 2), pp. 55-61.

[5] Mishra Kumar. N.; Mishra Nishchol. (2015): Load Balancing Techniques Need Objectives and Major Challenging in Cloud Computing -A Systematic Review. International Journal of Computer Applications, **131**(18), pp.11-19.

[6] Ravi . V; Kanakala Teja; Reddy Krishna .V. (2015): Performance Analysis of Load Balancing Techniques in Cloud Computing Environment. Telkomnika Indonesian Journal of Electrical Engineering,**13**( 3), pp.568-573.

[7] Nema Lekha; Sharma Avinash; Jain Saurabh.(2016):Load Balancing Algorithms in Cloud Computing. International journal of Engineering Science and Computing, **6**(6),pp. 7463-7468.

[8] Verma .P; Shrivastava Sonika; Patriya.K. R.2017): Enhancing Load Balancing in Cloud Computing by Ant Colony Optimization Method. International Journal of Computer Engineering in Research Trends, **4**(6), pp. 277-284.

[9] Rajeshkannan.R;Aramudhan.M.(2016):Comparative Study of Load Balancing Algorithms in Cloud Computing Environment.Indian Journal of Science and Technology, 9(20),pp.2-7.

[10] Kaur Amanpreet ; Bansal.G.(2016): Enhancement of Dynamic Load Balancing Using Particle Swarm Algorithm in Cloud Environment. Journal of Computer Engineering, **18** ( 4), pp.06-10.

[11] Amdani. S.Y; Malani .S.S.(2015) : A Study of Load Balancing in Cloud Computing using cloud partitioning and ACO. International Journal of Engineering and Technical Research, **3**(4), pp.333-335.

[12] Pathak.P; Mahajan Kamna.(2015): A Pollination Based Optimization for Load Balancing Task Scheduling in Cloud Computing. International Journal of

Advanced Research in Computer Science, **6**(7) , pp.7-12.

[13] Patel .G; Mehta Rutvik; Bhoi Upendra.(2015): Enhanced Load Balanced Min-Min algorithm for Static Meta Task Scheduling in Cloud Computing. 3rd International Conference on Recent Trends in Computing Procedia Computer Science, pp.545-553.

[14] Kumar. M; Sharma .C.S. (2017): Dynamic load balancing algorithm for balancing the workload among virtual machine in cloud computing. 7th International Conference on Advances in Computing &Communications, pp.22-24.

[15] T Mubarak.S; Rangesh.V; Srikanth Umarani.G;.(2017):A Survey on Load Balancing in Cloud Computing Using Optimization Techniques. International Journal of Research and Engineering, **4**(1), pp.28-30.

[16] Baby. A.(2014) : Load Balancing In Cloud Computing Environment Using PSO Algorithm, International Journal for Research In Applied Science And Engineering Technology,**2**(4), pp.156-163.

[17] Moharana,et al.(2013):Analysis of Load Balancing in Cloud Computing. International Journal of Computer Science and Engineering, **2(** 2), pp.101-108.

[18] Makasarwala .A.H.; Hazari Prasun. (2016) : Using Genetic Algorithm for Load Balancing in Cloud Computing. International Conference -8th Edition Electronic Computers and Artificial Intelligence.

[19] Jha C.K ; Bhola Anup; Kaushik.Y. (2015) : A Comparison of heuristics algorithm for load balancing in cloud environment. International Journal of Scientific &Engineering Research, **6**( 9), pp.1208-1214.

[20] Alamin.A.M; Elbashir.K Murtada; Osman.A. Abdullah.(2017): A Load Balancing Algorithm to Enhance the Response Time in Cloud Computing. Red Sea University Journal of Basic and Applied Science, **2** (2), pp.473-490.

[21] Mohapatra .S; Rekha Smruti.K; Mohanty Subhadarshini.(2013): A Comparison of Four Popular Heuristics for Load Balancing of Virtual Machines in Cloud Computing. International Journal of Computer Application,**68** (6), pp.33-38**.**

[22] Hung Cong.T; Phi Xuan Nguyen.(2016): Study the Effect of Parameter to Load Balancing in Cloud Computing . International Journal of Computers Networks and Communications, **8**(3), pp.33-45.

[23] Ghumman N.Singh; Sachdeva Rajesh.(2016):An Efficient Approach for Load Balancing in Cloud Computing Using Composite Techniques, International Journal of Research in Engineering and Applied Sciences,**6**( 2), pp.145-149.

[24] Dasgupta,et al.(2013): A Genetic Algorithm based Load Balancing Strategy for Cloud Computing.International Conference on Computational Intelligence: Modeling Techniques and Applications Procedia Computer Science, pp.340-347.

[25] Patidar Shyam; Rane Dheeraj; Jain Pritesh.(2012):A survey Paper on Cloud Computing . Second International Conference on Advanced Computing & Communication Technologies,pp. 394-398.

[26] Putha ,et al.(2015): Cloud Computing Features,Issues and Challenges: A Big Picture. International Conference on Computation Intelligent and Networks,pp. 116-123.

[27] Satish, Karuturi S R V, and M Swamy Das. "Multi-Tier Authentication Scheme to Enhance Security in Cloud Computing." IJRAR (International Journal of Research and Analytical Reviews) 6, no. 2 (2019): 1-8, 2019.