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LOAD BALANCING AND VIRTUAL MACHINE MIGRATION MODEL FOR DELAY REDUCTION IN CLOUD SENVIRONMENT

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ABSTRACT:

The center of the cloud is thought to be the data center. Lately, data centers have been under increasing strain due to the rising demand for cloud computing services. Cloud computing patterns are highly dynamic in terms of workload and system behavior, which may help to balance the pressure on data center resources. Some data center resources may eventually become overloaded or underloaded, which increases energy consumption in addition to causing diminished functionality and resource waste. With the help of the reliable cloud computing paradigm, individuals and businesses can buy the services they need, as needed. Numerous services, including storage, deployment platforms, easy access to webservices, and soon, are provided by the model. One major problem in the cloud that makes things difficult is load balancing. The progress of cloud computing in information technology has been remarkable. Customers can take use of a number of services offered by cloud technology only in the presence of an internet connection. Load balancing is regarded as a key problem in cloud computing that has challenged academics in this field. Basically, load balancing increases system efficiency and user happiness by distributing work across computer resources in an equitable and effective manner. Numerous load-balancing strategies attempted to increase system performance and efficiency by employing metaheuristic algorithms to handle this issue. This research proposes a Virtual Machine Frequent Load Analysis with Time Specific Migration (VMFLA-TSM) for load balancing in cloud environment.

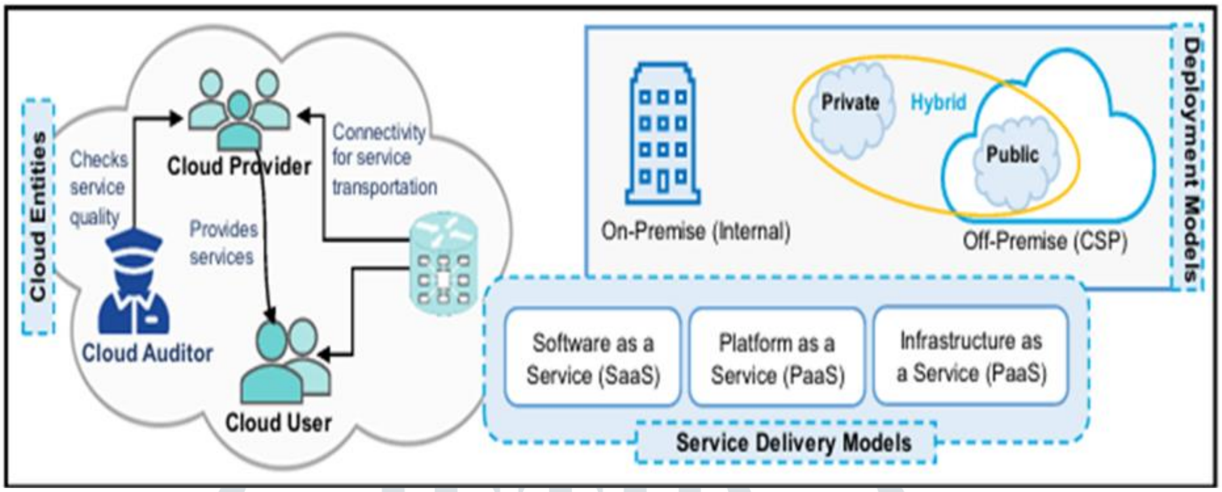
Key Words: Cloud computing Live virtual machine migration Pre-copy Dirty page rate.

1.INTRODUCTION:

A modern computer technology for providing services to clients on demand is the cloud environment. This technology makes it easier to access information on a variety of devices, including PCs, smartphones, and These days, cloud computing is seen as a global trend with numerous benefits across three types of cloud services: platform as a service (PaaS), software as a service (SaaS), and infrastructure as a service (IaaS).A large number of customers, businesses, and other entities are moving their information, data processing, and other assets to cloud computing platforms.A modern computer technology for providing services to clients on demand is the cloud environment. This technology makes it easier to access information on a variety of devices, including PCs, smartphones, and These days, cloud computing is seen as a global trend with several benefits across three types of cloud services: platform as a service (PaaS), software as a service (SaaS), and infrastructure as a service (IaaS).A large number of customers, businesses, and other entities are moving their information, data processing, and other assets to cloud computing platforms.To provide customers with services quickly, resources are dispersed over the globe[1],[2].When cloud computing initially started to take off, a number of issues were encountered, including resource scheduling, data energy consumption, security, QoS management, scalability, data lock-in, and capable load balancing[3],[4].Thus, load balancing the energy usage of the cloud and its servers[5, 6].The practice of allocating and reassigning the load amount of available Three tiers of services make up the quickly expanding field of cloud computing: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)[10-20]. Virtual machines (VMs) are used to assist physical machines (PMs) in order to increase computational efficiency[21-25]. Allocating a new virtual machine to the PM and managing the already-allocated virtual machines are the two problems with VM allocation to the PM, though. The four components of an energy-efficient cloud architecture, or "green cloud," are the physical machine (PM), virtual machine (VM), cloud-service allocator (CSA), and consumer or broker[26-32]. The modified best fit decreasing utilization (MBFD) architecture, an expansion of the best fit decreasing technique (BFD), may be used to allocate virtual machines.Virtual machines are allocated using the MBFD technique[33-39].The ability to provide computer hardware and software resources as online services that are available via the internet is known as cloud computing.[40-45]
resources to optimize throughput, reduce response time costs, and enhance resource performance and utilization Three tiers of services make up the quickly expanding field of cloud computing: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a

Service (SaaS). Virtual machines (VMs) are used to assist physical machines (PMs) in order to increase computational efficiency. Allocating a new virtual machine to the PM and managing the already-allocated virtual machines are the two problems with VM allocation to the PM, though. The four components of an energy-efficient cloud architecture, or "green cloud," are the physical machine (PM), virtual machine (VM), cloud-service allocator (CSA), and consumer or broker.[46-50]

Fig 1: Overview of Cloud Computing



2.LITERATURE SURVEY:

[1] In their 2021 article, N.Z. Jhanjhi et al. discuss various load balancing techniques in cloud computing, with a particular focus on adaptive load distribution and the Algorithm for Load Balancing Inspired by Nature (NLB). The authors emphasize the capacity of dynamic algorithms to adjust to changing circumstances in real time without requiring prior information. NLB algorithms are noted for their ability to manage dynamic, complex systems, making them essential for improving the efficiency of cloud computing environments. These dynamic algorithms stand out for their adaptability to real-time conditions by considering the current state of the system, which enhances their efficiency for distributed cloud systems.

[2] In their 2022 article, Suman Sansanwal et al. delve into the Inquisitive Genetic Grey Wolf Optimization (IG-GWO) algorithm, addressing the fundamental issue of load balancing in cloud computing. Load balancing, crucial for ensuring fair and efficient distribution of work among computing resources, ultimately enhances user satisfaction and boosts system productivity. The article discusses existing load balancing techniques and identifies research gaps in the current literature. To address these gaps, the authors propose the IG-GWO algorithm, which combines the Grey Wolf Optimization (GWO) algorithm with genetic algorithm principles, aiming to improve load balancing efficiency and effectiveness in cloud computing environments.

[3] In their 2019 article, Mohammed Ala'anzy et al. employ a methodical review approach to evaluate and condense findings on load balancing and server consolidation in cloud computing environments. The article discusses the potential future expansion of the meta-analysis to encompass aspects such as task load balancing and job scheduling, with the aim of developing a more comprehensive taxonomy. The study thoroughly analyzes various methods and approaches employed in research papers to achieve load balancing and server consolidation. By providing in-depth reviews of previous studies, the authors offer valuable insights into a wide range of research methodologies related to these topics. The study also acknowledges the influence of servers and load balancing on the overall performance of cloud computing systems.

[4] In their 2017 paper, Chih-Hung Wu et al. introduce a two-stage genetic mechanism for the migration-based load balancing of virtual machine hosts (VMHs) in cloud computing. Unlike previous methods that typically treat this issue as a job assignment optimization problem and only consider the current loads of VMHs, this study takes a more comprehensive approach. Virtual machines (VMs) are extracted based on their creation parameters and corresponding performance metrics within a cloud computing environment. Gene expression programming (GEP) is employed to generate symbolic regression models that describe the performance of VMs and the loads of VMHs post-load balancing. The proposed method is evaluated in a real cloud computing environment, Jnet, where the techniques are implemented as a centralized load balancing mechanism.

[5] In their 2022 paper, Puthal et al. focus on minimizing migration costs while maintaining system load balancing and meeting certain quality of service (QoS) requirements through dynamic virtual machine (VM) scheduling among limited physical nodes in a heterogeneous cloud cluster. Efficient resource scheduling is critical for big data centers in clouds to provide continuous services to users. Many existing scheduling schemes are based on tasks assigned to VM providers. The paper introduces the concepts of a consolidation score, an array mapping, and a tree crossover model, alongside an improved genetic algorithm (GA) designed to address these conflicting objectives. A joint optimization function is developed for an overall evaluation based on a load balancing estimation method, aiming to optimize both load balancing and QoS in cloud computing environments.

[6] In their 2023 research, Amel Ksibi et al. present a revolutionary method for cloud computing intrusion detection, integrating a deep-learning model (DLM) with filter-based ensemble feature selection (FEFS) to enhance intrusion prediction. The DLM combines Tasmanian devil optimization (TDO) with a recurrent neural network (RNN) to find optimal weighting parameters. By using FEFS to select key features for training the deep-learning model, the study improves performance measures such as sensitivity, F-measure, precision, recall, and

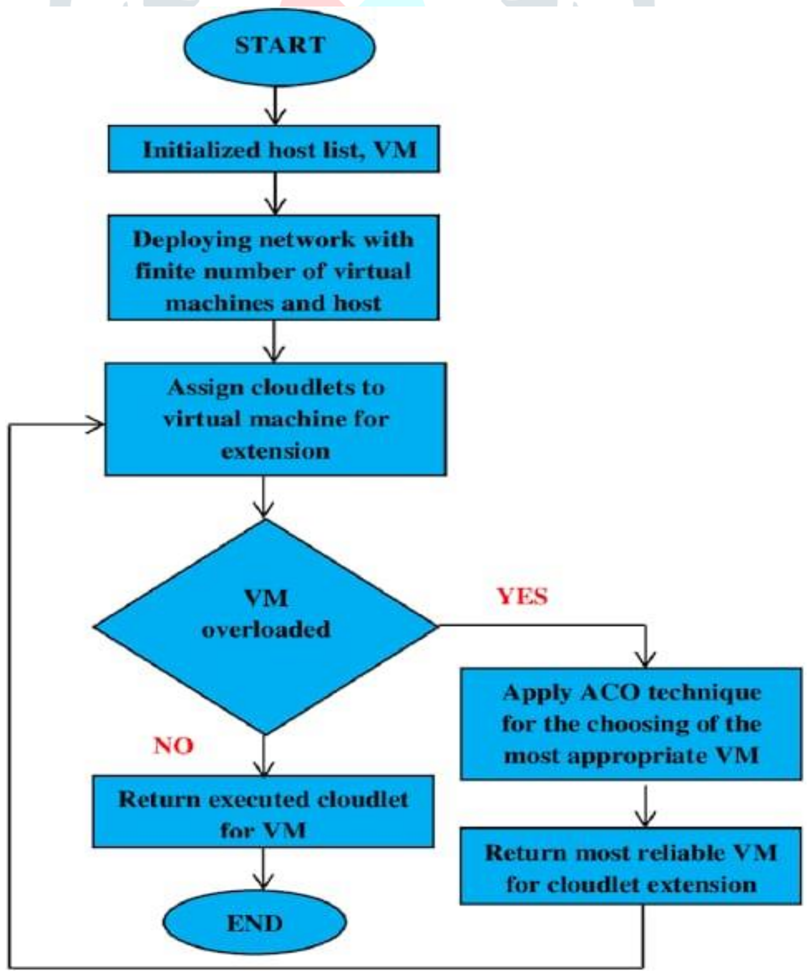
accuracy. Comparing this novel approach with traditional methodologies highlights its advantages in intrusion detection tasks within cloud computing environments.

3.PROPOSED METHODOLOGY:

The methodology of the proposed algorithm is centric, as per the written objectives. The first objective is to analyse existing VM allocation and migration techniques in which the focus would be towards studying SESA, MBFD, and its other enhancement. The design of the proposed algorithm is divided into two segments, namely the organization of the clusters and the placement of VMs into the concerned clusters. Considering the VMs to be migrated, as per the MM algorithm, Nashaat et al. [8] in 2019 proposed a smart elastic scheduling algorithm (SESA) which clusters the VMs . migrate. Nashaat modified the k-means algorithm by using RAM and CPU utilization of the VMs and the host. In order to modify the k-means algorithm, Nashaat used Euclidean distance (ED). This paper propsoes a Time Constraint Load Balancing and Virtual Machine Migration Model (TCLBVMM) for delay reduction in cloud environemnt. This technology makes it easier to access information on a variety of devices, including PCs, smartphones, and These days, cloud computing is seen as a global trend with several benefits across three types of cloud services

LOAD BALANCING MODEL:

In order to effectively spread workloads and computing resources over numerous servers and guarantee optimal performance, dependability, and service availability, load balancing is an essential strategy in cloud computing. It includes splitting up incoming workloads or network traffic among several servers in order to avoid server overload and reduce response times. Reducing the amount of time it takes to execute a request and provide theuser with a response is known as delay reduction.Virtual machine (VM) migration, adaptive load distribution, dynamic resource allocation, and task prioritization are common components of load balancing algorithms intended to reduce latency. This technology makes it easier to access information on a variety of devices, including PCs, smartphones, and These days, cloud computing is seen as a global trend with several benefits across three types of cloud services. One example of an IaaS application is virtualization, which offers web services as a means of delivering computer infrastructure resources. IaaS companies buy, operate, and provide consumers online services in addition to real computer and storage gear. Virtual machines, or VMs, have the potential to operate one or more VMs at a time. Inadequate VMH management, however, may result in uneven task allocation. The usage of resources that virtual machines (VMs) hold must be adjusted in order to handle load balancing.



Algorithm:

node [1..n]; plane [1..axis_size];
Local variables (Acc_Work, Work_Start, Work_End)
1: For each plane of received sub-volume (uniform data partitioning)
2: Compute Workload by using Coarse-Grid with pre-defined grid size
3: Compute Workload of other planes by using linear interpolation
4: End For
5: Send Workload[plane] to all other nodes
6: Receive Workload[plane] from other nodes
7: Calculate Total_Workload = SUM (Workload[plane])
8: Calculate Threshold = Total_Workload/n (quantity of nodes)
9: For (node = 1 to n); plane = 1;
10: If (node == even); Acc_Work = 0; Work_Start = plane
11: While (Acc_Work <= Threshold)
12: Acc_Work += Workload[plane]
13: Increment plane
14: Work_End plane
15: else (node != even); Acc_Work = 0; Work_Start = plane
16: While ((Acc_Work + Workload [plane]) <= Threshold)
17: Acc_Work += Workload[plane]
18: Increment plane
19: Work_End = plane
20: New_Sub-volume= [Work_Start.. Work_End]
21: End For

VIRTUAL MECHINE MIGRATION:

In the final analysis, good performance, dependability, and user happiness in cloud environments require a load balancing algorithm built for delay reduction. Through the use of sophisticated strategies like predictive models and agent-based systems, dynamic resource allocation, load balancing, and other techniques, these algorithms can drastically cut down on latency and improve cloud service efficiency.In cloud computing environments, virtual machine migration (VM) is an essential strategy to enhance system performing balancing, and resource usage. Reducing delays and maintaining service quality are the objectives of the minimally disruptive virtual machine (VM) transfer process from one physical host to another. Pre-copy and post-copy migration are two examples of live migration algorithms that minimize downtime during the final switchover. For the least amount of downtime and fastest migration, trade-offs are balanced using network-aware migration algorithms, dynamic resource scheduling, and optimized resource allocation. Pre-copy and post-copy methods are balanced in hybrid migration tactics to cause the least amountof disturbance. Incremental migration, parallel migration, and data compare.

ALGORITHM:

Input: P, V, m = |P|, n = |V|, max = 0.0;
Output: Pactive, $VMSet_p$, k=0, s
1. for each PM p ∈ P
2. , $VMSet_p$= Null;
3. endfor
4. for each VM v of V
5. for each PM p of P
6. if ($C_v \leq T^{\wedge cpu}_p$ && $M_v \leq T^{\wedge mem}_p$ && max < RUF (p, v)) then
7. max = RUF (p, v)
8. q=p;
9. endif
10. endfor
11. $VMSet_q = VMSet_q \cup \{v\}$
12. $T^{\wedge cpu}_q = (T^{\wedge cpu}_q - C_v)$; $T^{\wedge mem}_q = (T^{\wedge mem}_q - M_v)$;
13. if q is not belongs to Pactive then
14. Pactive = Pactive ∪ {q};
15. k++;
16. endif
17. endfor
18. s=m-k;
19. Call VM migration

4.RESULTS AND DISCUSSIONS:

An analysis of the reviewed elements of this meta-study on server consolidation and load balancing is presented in this part. Therefore, these are the issues that currently surround cloud computing. Once we competently reach the maximum utilization of the resources, we will be able to improve resource utilization, reduce energy consumption, and lower carbon emissions for servers that are efficient in the cloud while maintaining QoS and SLA violations. The findings demonstrate that virtualized clusters and data centers can benefit from the migration process, which enables more flexible control of the physical resources that are accessible. This is achieved by enabling infrastructure maintenance and load balancing without sacrificing the responsiveness and availability of applications.

The outcomes demonstrated various load balancing scenarios, with advanced achieving 95% and basic achieving 80%. The outcomes demonstrated notable gains in performance.In a cloud setting, the suggested load balancing methodology dramatically lowers system throughput, load distribution efficiency, and average response time. To maximize resource allocation, it combines proactive load redistribution, predictive analytics.

Cloud Users Considered	Models Considered		
	VMFLA-TSM Model	IALB-VMCE Model	MbLB-VM-BM
50	10.9	16.2	19.0
100	11.2	16.4	19.4
100	11.2	16.4	19.4
150	11.4	16.6	19.5
200	11.45	16.6.5	19.55
250	11.5	16.7	19.6

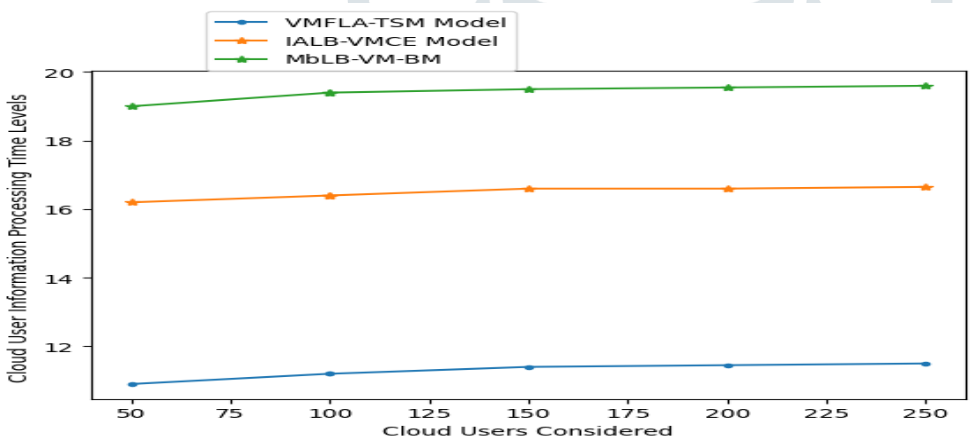
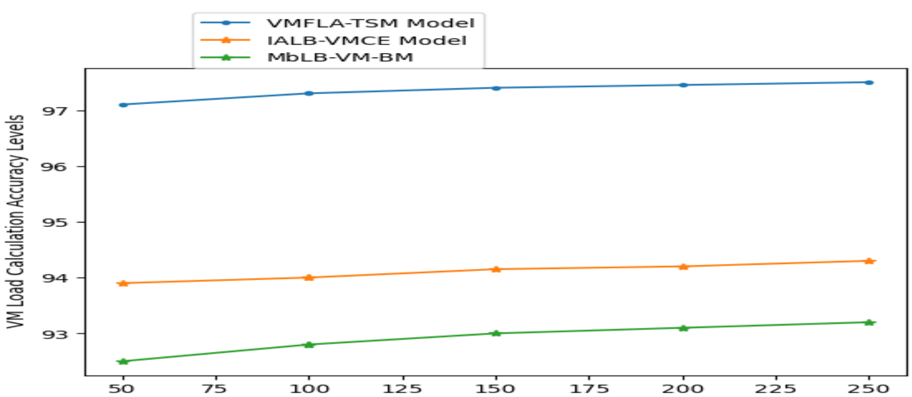


Fig: Cloud User Information Processing Time Levels

The graph compares the performance of three models—VMFLA-TSM, IALB-VMCE, and MbLB-VM-BM—in terms of cloud user information processing time levels across varying numbers of cloud users, ranging from 50 to 250. The **VMFLA-TSM model** consistently exhibits the lowest processing times, starting at around 12 units for 50 users and increasing only slightly as the number of users grows.This suggests that the VMFLA-TSM model is the most efficient and scalable option, especially as the number of cloud users increases. The **IALB-VMCE model** starts with a higher processing time of approximately 16 units and remains stable, showing little fluctuation as the number of users increases.



Cloud Users Considered	Models Considered		
	VMFLA-TSM Model	IALB-VMCE Model	MbLB-VM-BM
50	97.1	93.9	92.5
100	97.3	94.0	92.8
100	97.3	94.0	92.8
150	97.4	94.15	93.0
200	97.45	94.2	93.1
250	97.5	94.3	93.2

Fig: VM Load Calculation Accuracy Levels

The graph compares the performance of three cloud models—VMFLA-TSM, IALB-VMCE, and MbLB-VM-BM—based on their cloud user information processing time levels as the number of cloud users increases from 50 to 250. The **VMFLA-TSM model**, represented by the blue line, shows the lowest processing time, starting around 12 units and increasing gradually as more users are considered, demonstrating its

Cloud Users Considered	Models Considered		
	VMFLA-TSM Model	IALB-VMCE Model	MbLB-VM-BM
50	97.7	94.1	93.1
100	98.09	94.35	93.2
100	98.09	94.35	93.2
150	98.1	94.3	93.25
200	98.15	94.44	93.3
250	98.2	94.6	93.4

efficiency in handling growing user numbers.

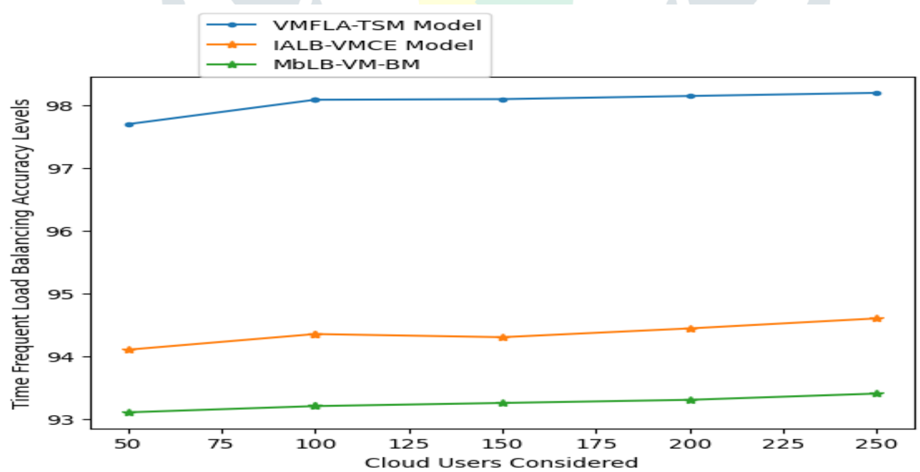


Fig: Time Frequent Load Balancing Accuracy Levels

This graph compares the **Time Frequent Load Balancing Accuracy Levels** of three models—VMFLA-TSM, IALB-VMCE, and MbLB-VM-BM—as the number of cloud users increases from 50 to 250. The **VMFLA-TSM model**, represented by the blue line, consistently shows the highest accuracy, starting above 98% and maintaining this level as the number of users increases. This indicates that the VMFLA-TSM model provides the most accurate load balancing performance regardless of the number of cloud users.

Cloud Users Considered	Models Considered		
	VMFLA-TSM Model	IALB-VMCE Model	MbLB-VM-BM
50	15.04	21.25	21.87
100	15.23	21.52	22.1
100	15.23	21.52	22.1
150	15.3	21.62	22.15
200	15.42	21.75	22.29
250	15.5	21.8	22.4

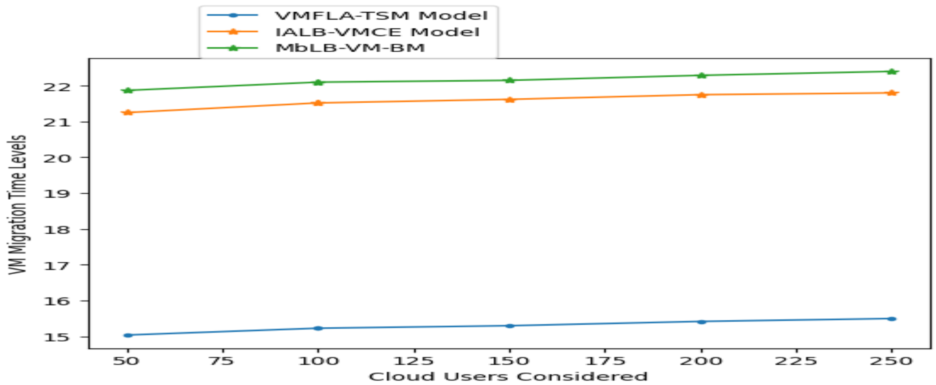


Fig: VM Migration Time Levels

The **VM Migration Time Levels** in the graph likely compare how three models—VMFLA-TSM, IALB-VMCE, and MbLB-VM-BM—perform in terms of the time required to migrate virtual machines (VMs) as the number cloud.

Cloud Users Considered	Models Considered		
	VMFLA-TSM Model	IALB-VMCE Model	MbLB-VM-BM
50	96.1	95.0	93.13
100	96.33	95.11	93.32
100	96.33	95.11	93.32
150	96.5	95.2	93.44
200	97.6	95.25	93.73
250	97.8.	95.3	93.8

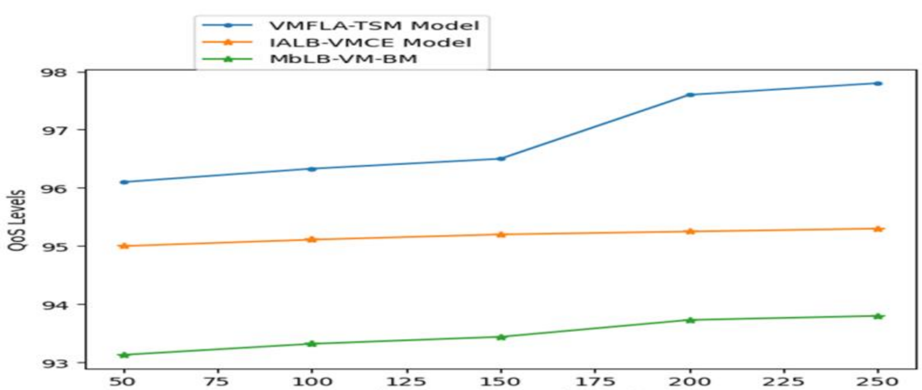


Fig: Qos level

The **Quality of Service (QoS) Levels** in the context of the graph likely represent how well each model—VMFLA-TSM, IALB-VMCE, and MbLB-VM-BM—ensures reliable, efficient, and optimal service to cloud users as the number of users increases.The QoS is a critical metric in cloud environments as it measures the performance -consistency and service guarantees (like uptime, response times, and availability) provided to users.

5.CONCLUSION:

The body of research on server consolidation-based load balancing has been examined in this meta-study. Numerous techniques have been examined through a thematic taxonomy that highlights the commonalities among them. In addition to optimizing resource management in cloud data centers, the examined approaches significantly lower overall energy use. The review provides an overview of over a thousand studies' worth of load balancing techniques. Additionally, the goal of this review was to look at the history of each approach that was studied, the papers' overall content, and the difficulties that different methods posed..

The following conclusions were reached after comparing all the technologies using in the performance measurements and overheads covered in the review:The majority of virtual machine algorithms merely make decisions about where or when to migrate the virtual machine. Few studies took into account both deciding variables. Although early and late handover is a crucial component of real-time applications operating on the fog layer,it was not taken into account in the majority of research..

To sum up, the utilization of virtual machine migration and load balancing techniques greatly improves delay reduction in cloud environments. These approaches optimize speed, reduce latency, and optimize resource use by allowing virtual machines to travel seamlessly across servers and dynamically dispersing tasks among them.

Subsequent efforts ought to concentrate on enhancing these models through sophisticated machine learning methodologies in order to anticipate workload trends and mechanize decision-making procedures. As a result, cloud infrastructures will be even more efficient and scalable, opening the door for cloud services that are more responsive and resilient. In an increasingly demanding digital market, adopting these methods is vital for firms hoping to enhance performance and minimize operational delays.

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