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SURVEY ON VIRTUAL LOAD BALANCING ARCHITECTURES IN MOBILE CLOUD

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Abstract: The mobile cloud computing, that enables the mobile device application to be hosted, equipped and constructed by the cloud-computing has become more prominent among wide range of application and the concerns that range either in the small-scale or the large-scale. This lead to the overcrowded accessing of the mobile clouds which lead to insufficiency of resources and the latency in the service provisioning. The possible researches emerged with the solutions of load balancing, but the in capabilities in the traditional load balancing developed were in compatible with the mobile cloud computing. So the paper details the survey on the virtual load balancing techniques available and their employment in the mobile cloud computing to improve the balancing of the influx traffic that are addressed towards the mobile cloud computing.

Keywords: cloud –computing, virtual load balancing, Mobile cloud computing, guaranteed servicing and traditional load balancing.

1. Introduction

The cloud computing that has become very essential in handling of large scale of information, has become prominent in constructing, hosting and powering of the mobile application paving to the emergence of the mobile cloud computing that integrates the mobile-computing and the cloud-computing. This approach coined as the mobile cloud ensures the users in developing an application that is accessible by the mobile devices irrespective of the operating systems of the devices and their capabilities in terms of processing and storage. The mobile cloud approach is aided with the key characteristics of quick development, of variety of applications, by using the elastic resource provisioning of the cloud and the network technologies. This allows the extending of an uninterruptable services (reserve, functionality, speed) among numerous of devices irrespective of their operating system, from anywhere, at any time on pay –per-use, provided the devices are connected over the internet. So the seamless provisioning of the services such as heightened storage capabilities, enhanced battery life, processing time and communication etc. in a cost –effective way has enticed multitudes of users, small scale and the large scale concerns, to adapt to the mobile cloud provisions. As numerous of client engage in adapting to the mobile-cloud, it

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becomes necessary to handle a huge amount of services requested for [17]. So the mobile cloud computing encounters challenges in providing a guaranteed services due to the overcrowded request for the services.

Handing over the partial load of the mobile cloud to the cloudlets or the locally available cloud, would result in the delay in the service provisioning and insufficiency of the resources. So the solution for the over crowd would be the load balancing. The work of the load balancing is to segregate the incoming traffic and allot it to the different servers available at the backend. Thus maintaining the guaranteed service provisioning, improving the processing power, response time, connections to the applications and the reducing the over loading,

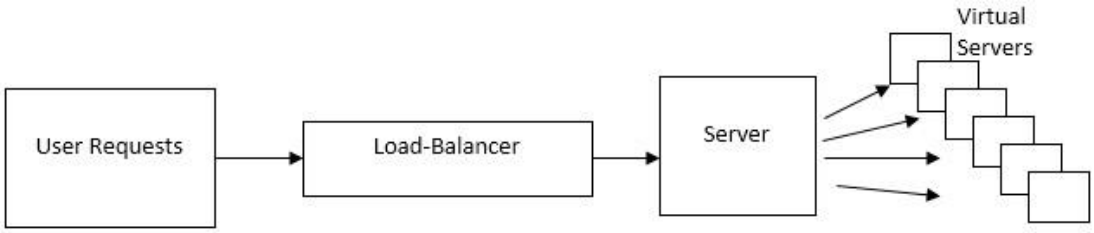

Fig 1 Load-Balancer

As shown in the Fig 1 the load balancer is placed between the clients who requests for the service and servers that are engaged in receiving the requests, once the requests are been received, they are dispersed to the multitude of the servers available in the backend using the load balancing, reducing the server load and application failures. The traditional balancing techniques, used a dedicated hardware load balancers that were expensive and occupied more space, the operation provisioning were also inflexible, so this lead to the development of the software load balancer that were non-programmable as they were locked by the vendor[23]. The in-capabilities of the traditional load balancing techniques made them unsuitable for the mobile cloud computing. So there arouse a need for the development of the load balancing that are compatible with the cloud and are reprogrammable as per the needs in the balancing of the load.

So the paper presents the survey on the virtual load balancing for the mobile clouds, presenting the available methods of the load balancing in the cloud that could be employed to balance the heavy flow of the service request that are projected towards the mobile cloud computing .

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The paper below proceeds with 2. Introduction to the load balancing and the Virtual load balancing, 3. The methods of load balancing, 4. The improvement in the mobile cloud if the balancing techniques are employed, 5.Conclusion and the future enhancement.

2. Virtual Load Balancing

The tremendous increase in the flow of information and the need for their timely processing, requires an efficient method in handling them. This paved way for the load balancing [1], [2] techniques that allowed the construction of flexible paradigms with the enhancement in their performance in managing the variety of influx data's and applications that appear complex due to the heavy data-flow. There are hardware and software load balances available, the balancing method takes the key role in making a network successful.

The success in the load balancing lies in the effective handling of the inflowing traffic, irrespective of the size of the concern or the application. This is where the virtual balancing for the load comes into existence. The virtual balancing divides the inflowing traffic among different available servers, to overcome the difficulties encountered by overloading problem and manage the loads with flexibility [11]. The virtual balancers of the load allows the software available for the load-balancing of the physical application to run on the virtual machines[46],[47] the key characteristics of the software-balancers enable them to employed in the following areas that require, parallel computation, comprehensive tracking, reporting, stability and accuracy as shown in the table.1

Table .1 Key Characteristics of the Software Load Balancer

S.No	Areas that require	Key characteristics
i	Parallel Computation	Reduces the total amount of resources used Maintains and increases the system performances Saves Time and Money
ii	Comprehensive Tracking and reporting	Makes sure whether the servers are connected Reduces the down time
iii	Stability and accuracy	Maintains the record of the relevant information Helps in identifying the weak spot or the strong spot that is related to the server system.

2.1 Virtual Balancing- Algorithms

The balancing techniques is classified into (i) static – that disperses the incoming load to the server without the prior knowledge of the server status [1],[2] and (ii) dynamic – gains the prior knowledge of the server and

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disperses the load only to the least loaded server,[50],[1],[2]. The algorithms that help in the balancing techniques and their uses are listed out below in table.2 .Based on the reviews gathered from the research's and the survey from the, Ghomi, et al [1] presenting the load balancing algorithms, the load balancing mechanism and the uses given by the Milani et al [2] the uses and the advantages gained from the comparative study of the Randles, et al [18], and Joshi et al [24], the table 2 lists out the balancing-algorithms available for the improvement of the system performance.

Table 2. Balancing-Algorithms and their Advantages

S.No	Balancing Algorithms	Functioning	Advantages
1	Next in loop	Rotates the service list and assigns the server with the top-most service and moves	Simple and easy to Implement Usually preferred for the servers with the similar specifications.
2	Weighted-Round Robin	Similar to round robin but ,spits larger share of services to certain servers	Best suited for critical applications.
3	Least Response Time	Opts for the least connected and least response time servers	Increases the throughput, by reducing the delay in the servicing.
4	Least Connection	Opts servers with least connection	Makes sure, no servers are overloaded or idle.
5	Least Bandwidth	Usually engaged with the services requiring least traffic	Allows full bandwidth utilization
6	Least Packet	Engages with the servers that usually handle lowest number of packets.	Ensures reliability in the servicing
7	Custom Load	Selects the serves handling the least load	Enables better resource utilization

2.2 Confrontations in the Mobile Cloud Based Load-Balancing

In prior to the review on the load balancing techniques, the paper includes the issues that are present in the mobile clouds related to the virtual balancing of the load. The survey on the issues of the virtual balancing of the load are presented below under the following topics as reviewed from the Ghomi et al [1], Milani, et al [2], Rukman, and Rubal[41], RaviTeja et al [53] and Al Nuaimi et al [29].

i. Dispersed Data point of M-Cloud: The data points of the mobile cloud being in a dispersed nature, cause challenges in the balancing of the load as the balancer has to concentrate on the, bandwidth, congestion status, speed on the conveyance and the distance between the data points as well as the user and the service provider.

ii. Migration of the VM (virtual-machines): As them M-cloud offers the service on demand from anywhere, at any time to any people. Few services would cause the migration of the VM's from one server to the server located far

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away. This process challenges the balancer as it has to take into consideration the time taken for migrating and the security services against the vulnerabilities.

iii. Failure of a Single Data Point: The centralized natured balancing algorithms, when employed in cloud, would pave way for a system crash, due to the failure of the single data point. So this causes the confrontation to the balancer as it has to be designed in the decentralized nature.

iv. Cloudlet inclusions in the M-cloud: The Cloudlet included would cause delay in handling of the services, thus increasing the response time.

v. Power utilization: The minimum resource usage of the M-cloud would result with the maximization of the energy consumption. So it is necessary for the balancer to monitor with the maximum utilization of the resources to achieve minimum energy usage.

The following section presents the survey on the prevailing virtual load-balancing methods available for the cloud followed by the improvement that could be attained in the mobile-cloud on using the load-balancer in the next section.

3. Survey on Virtual-Balancing for loads on M-Cloud

The section conveys the virtual balancing of the cloud services from the survey conducted on the prevailing methods of the balancing. Some of the load balancing covered in the survey are the adaptive balancing by the Fardbastani et al [6], that uses the adaptive balancing of the load, by parallelizing the events, in support to the heterogeneous engines with the rule partitioning and also supports the migration of VM at low cost and limited response time. Secure balancing Puthal et al [8] incorporates the authentication technique along with the dynamic balancing of the load for the cloud services, with the validation for the efficiency and the stability. Sustainable load-balancing Deepak et al [3] uses the dynamic loading algorithm to handle the load efficiently, making the performance sustainable in terms of the response time, scalable balancing for the load in cloud Desmouceaux et al [4] develops an application ware scalable balancing that functions based on the category that the balance has the prior knowledge of the status of the application, operates below the application layer , does not incur any monitoring overhead and with the ability of providing balance for the distributed data points of the cloud. This proposal promotes a 6LB balancer that is application aware, yet independent of the application and the application layer protocol and without relying on the centralized monitoring. Resource-efficient load-balancing Rehman et al [22], it utilizes the round robin, PSO and the threshold balancer to provide a maximum resource utilization in order to reduce the energy consumption by combining of the smart grid with the cloud, the VM based load balancing shows efficient resource utilization in the PSO compared to the RR and the TLB, Zhang et al [25] and Patel et al [49] promotes an energy –aware LB that is used to avoid the energy consumption and the storage problems due to the imbalance in the load and also avoids

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unnecessary migrations. Distributed load Iranpour et al [20] two dynamic work load balancing are engaged in managing the load of the large scale SAAS. Here the fuzzy is used in the admission control for the cloud and the game theory is employed in the first layer load balancing, where the next layer uses either the RR or the LCM and Randles et al [18] the heuristics Li, et al [9], Zhao et al [31], LD et al[32], Adamuthe et al [42] and the metaheuristic aruna et al[45], the heuristics and the metaheuristic approaches for the load balancing employs the optimization technique based on the honey bee, PSO, GA, Tabu search and machine learning techniques for the balancing of the loads and enhance the performance in terms of response time, resource utilization, cost and the processing time. Agent based balancing Singh et al [39] maintains the details of the cloudlets and assigns the load calculating the load on each VM. It shows satisfactory results in terms of the reliability, throughput and fault tolerant. Predictive balancing for the load Yang et al [5] using the wild card mask the load balancing is directly provided for the router and the switches and include a user prediction mechanism to alter the range of the wild card mask dynamically, reduce the latency in the services of the cloud. The table 3 gives the précis of the prevailing balancing methods for the cloud.

Table.3 Survey on Virtual Load Balancing

Balancing technique	Research's	Concept	Merits	Demerits
Adaptive	Fardbastani et al (2019)	The essential goal is the balancing of the load for the data points with the multiple type resources of formal model	Reduces input event loss Increases the throughput. Increases network utilization.	High make span High download time between different cluster and servers
Scalable	Desmouceaux et al (2018)	Ensure a minimal overhead by allowing the LB to run exclusively with the IP forwarding plane.	Shorter Response time, negligible data path overhead, no out of band signaling	High make span Lower resource utilization
Secure	Puthal et al (2019)	Combines the dynamic load balancing techniques along with the authentication method.	Highly secure, better load-balancing and improved efficiency, in terms of reduced overhead for the data centers	High response time High Cost Lower scalability
Resource Efficient	Rehman et al(2018), Zhang et al (2019)	• Four layered fog-cloud and the	Energy efficient,	Rejected request Higher cost,

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Pages: 161-175
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	Patel et al (2019)	combined cloud and smart grid architecture are used to have the balance of load for the power request • Maintains load balance in the traffic flow by the adaptive path selection and opting quality path back up. • The energy-aware balancing is used to avoid the imbalance in the load causing irregularities in the load.	maximum resource utilization, enhanced storage, improved response time Lower migrations	
Distributed	Iranpour et al (2018) Randles et al (2010)	• The distributed algorithm for load balancing based on the self-adaptive fuzzy and the game theory is used • The study on the distributed algorithms	Improved load-balancing metrics Reduced request rejection	Increased computation time. Higher cost Increased migration overhead
Heuristic and Metaheuristic	Li, et al (2019) Zhao et al (2015), LD et al(2013), Adamuthe et al (2013) aruna et al(2017),	• Combines GA and PSO to have dynamic load balancing • Uses LB based on the Bayes clustering • The foraging behavior of the honey bee is used in LB • Uses GA and the Tabu search to split loads among the computing resources • Uses the foraging behavior of the firefly and the PSO	Reduced request rejections Enhanced throughput Optimized external services Better work load Distribution Improved response time Improved make span Improved degree of imbalance	Independent task Low scalability

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Agent based	Singh et al (2015)	Includes the options of local agents maintaining the details of the data centers and a channel agent that controls the transfer policy location and the selection policy	Lesser resource monitoring, heterogeneous server and VM	Increased over head due to migration Lower scalability
Predictive	Yang et al (2019)	Uses an WCM method and a user prediction method to provide LB directly to the routers or the switches and the change the range of the WCM dynamically	Reduced deviation Improved load balancing Improved response time	High make span High cost

The table 3 gives the precise of the virtual load balancing for the cloud along with the comparison of the performance metrics for the each balancing method. The table 4 shows the policies of the virtual balancing algorithms reviewed from Ghomi et al [1] and Milani et al [2]

Table. 4 Policies of the Virtual Balancing Algorithms

Policy	Description
Location	Engages the suitable server for the service and monitors the service that are to migrate with the partners
Transfer	Involves re-scheduling and the migration of the tasks.
Selection	Includes the factors that are to be considered for selecting a task (migration overhead and computation time.
Information	Demand driven, periodic and state change (estimates the time for the information transfer)

The location, transfer, selection and the information policies are used in estimating the data-point where the services are to be transferred, the conditions on the transfer, the service that are to be transferred and the time of the transfer respectively as shown in the table 4.

4. Improvement in the M-Cloud with the virtual Load-Balancer

Form the survey conducted, it is understood that the employment of the load balancer for the M-cloud services would improve the performance of the M-cloud with the following characteristics

Capable of handling sudden traffic flow.

Continuous service provisioning with heightened flexibility.

Improved scalability, adaptability, reliability, fault-tolerance and response time.

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http://irojournals.com/irosws/
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Suitable for high performance application.

Energy efficient and predictive.

The migration could be done at ease.

Crashing of the system could be avoided.

The mobile cloud could make sure the guaranteed performance for the service requested by the balancing techniques that are been employed. This could allow the user application to work faster and provide a better performance at a considerably lower cost. The efficient load balancing allows the cloud services to enjoy the scalability and the agility in maintaining the traffic, its distribution among the servers and the capability of handling sudden traffic surges. It offers an increased redundancy thereby protecting the cloud services from sudden outages. The failure in the single data point is easily overcome by handling the services to the next active data point offering a complete flexibility and fault tolerance. The table below gives the performance metrics of M-Cloud when engaged with the virtual load-balancing and the traditional load-balancing.

Table 5 Performance Improvement by Load balancing

Balancing Technique	Throughput	Response Time	Make Span	Cost	Fault-Tolerance	Migration Time	Degree of Imbalance	Energy Consumption
Adaptive	Moderate	Increased	High	Low	Yes	Low	Low	High
Scalable	High	Reduced	low	Low	Yes	Low	Low	Low
Secure	Low	Reduced	Low	High	Yes	Low	High	low
Resource Efficient	High	Reduced	Low	High	No	Low	Low	Low
Distributed	High	Increased	High	High	Yes	High	High	High
Heuristic and Metaheuristic	High	Increased	Moderate	Low	No	Low	High	Low
Agent based	Low	Reduced	Low	Low	Yes	High	Low	High

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Pages: 161-175
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Predictive	High	Reduced	High	Low	Yes	Low	High	Low
Traditional Load-balancing	Low	Increased	High	Low	No	High	Low	High

The table 5 gives the guaranteed servicing of the M-clouds with the some of the load balancing techniques (adaptable, scalable, sustainable, secure, distributed, heuristic-metaheuristic, predictable and the agent based) and the M-Clouds with the Traditional load balancing technique from the review conducted.

5. Conclusion

The paper presents the survey of the virtual balancing techniques, considering few prevailing methods of balancing for the mobile cloud overcoming its challenges and providing with the performance metric in-terms of throughput, response time, make span, cost, fault-tolerance, migration time, degree of imbalance and energy consumption. The paper presents the uses of the virtual-balancing, the necessaries areas of its deployment, the different balancing algorithms available and the survey on the various balancing techniques. Further the paper includes the improvement that could be made in the M-Clouds by the employment of the virtual balancing techniques. The study proceeded in the paper would make sure the guaranteed performance for the mobile cloud and in future work would be continued with the experimental results of the prevailing techniques surveyed and new techniques emerging with the comparative analysis of their performance.

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