International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2017 IJSRCSEIT | Volume 2 | Issue 5 | ISSN : 2456-3307

A Survey on Fault Aware Load Balancing and Power Efficient Scheduling in Cloud Computing

[1] S. Sivakumar, [2] V. Anuratha
[1] *Ph.D* Research Scholar, Sree Saraswathi Thyagaraja College, Pollachi,Tamilnadu, India
[2] Head, PG Department of Computer Science, Sree Saraswathi Thiyagaraja College, Pollachi, Tamilnadu, India

ABSTRACT

Resource allocation and load balancing in a cloud environment is a problem of interest in recent years. With the increase in number of request over the data centers and size of cloud infrastructure over time, increasing the load unbalancing and power consumption of the data center. So, the requests need to be balanced in such manner having a more effective strategy for resources utilization, request failure, and improved power consumption. Cloud computing made it more complicated with respective to requests types that affect the performance of system. In general, resource allocation and load balancing algorithm chooses an objective function to select a host with least resource utilization, power consumption to optimize the system performance and provide high Quality of Service.
Keywords : Resource Allocation, SaaS, PaaS, IaaS, Load Balancing.

I. INTRODUCTION

Distributed computing is a most far reaching and well known type of figuring, promising high dependability for clients and suppliers both at a similar purpose of time from many fields of sciences or industry. Customers from the diverse field are served by datacenters in cloud condition topographically spread over the world. Cloud serves an extensive number of solicitations originating from different sources over datacenter with high power utilization. Be that as it may, to give such a substantial processing power required an immense power, prompting high power utilization and cost. Demand sorts in cloud framework additionally influence the administrations which are open and private demands whose extent is irregular in nature. An overview in 2006 over the execution of cloud condition in the USA indicates datacenter expended 4.5 billion kWh units of energy, which is 1.5% of aggregate power devoured in the USA and this power prerequisite is expanding 18% consistently. By and large, distributed computing manages different issues live poor asset use and load adjusting and some more. A portion of the issues are talked as takes after: 1) as distributed computing devices are utilized by industry and they have issues with the quickly developing solicitation and various servers conveyed, expanding the power utilization. 2) Task designation of demand among datacenter without knowing about QoS gave by servers. 3) Current assignment distribution calculations just concentrate on adjusting the demand and enhance unitization of the framework yet not the disappointment likelihood of framework. 4) High stacked server farms have high disappointment likelihood and because of high load, this may prompt back off of datacenter and poor QoS (Quality of administration) to the customer and customer supplier. 5) While few of the servers are over-burden and some of them are sit out of gear or under stacked. 6) Some ask for should be registered with QoS however because of high load and blame rate they may the QoS guaranteed which is not fitting to the client and will be a basic issue. 7) according to late examination, usage of server farms is a noteworthy issue in light of the fact that 60% server farms are sit out of gear and the vast majority of 20% server farms are used and misuse of the assets.

This demonstrates the poor usage of assets yet this demonstrates the significance of another approach that has adequate procedure to limit squanders of assets and expanding unwavering quality by designating undertaking over assets which on account of Cloud is VM with low disappointment likelihood to give high QoS to clients. The current calculations just contemplate cloud as non-flawed in nature and neglect to give particular QoS when a blame happens. So to defeat these issues and enhance the execution of the framework, we have proposed approaches for asset stack adjusting and assignment. Figure-1 demonstrates distributed computing highlights, sort and different properties.

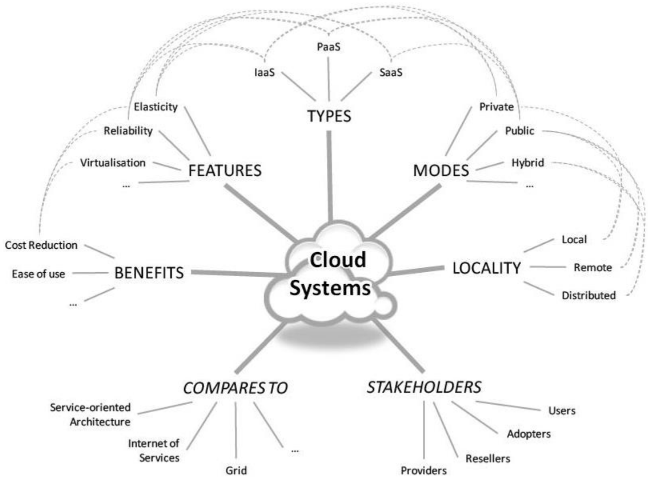

Figure-1: Cloud system characteristics and properties

II. CLOUD COMPUTING SERVICE MODELS

2.1 Software as a Service (SaaS)

The SaaS benefit display offers the administrations as applications to the shopper, utilizing institutionalized interfaces. The administrations keep running over a cloud foundation, which is undetectable for the purchaser. The cloud supplier is in charge of the administration of the application, working frameworks and fundamental foundation. The shopper can just control a portion of the client particular application setup settings. A pioneer in the business of SaaS is Salesforce.com, who is putting forth multitenant arrangements in the field of Customer Relationship Management (CRM) since before the presence of the idea of SaaS with regards to Cloud processing. A later case of this sort of arrangements is the email benefit offered by Google, i.e., GMail, through its Google App Engine. In these circumstances, the Cloud client is just inspired by getting the most out of the application gave by the Cloud. At this level the Cloud client is not seen as an engineer any longer, he is a basic client of arrangements offered by Cloud designers.

2.2 Platform as a Service (PaaS)

The PaaS benefit demonstrate offers the administrations as operation and improvement stages to the shopper. The buyer can utilize the stage to create and run his own particular applications, bolstered by a cloud-based foundation. The customer does not oversee or control the basic cloud framework including system, servers, working frameworks, or capacity, however has control over the sent applications and perhaps application facilitating condition configurations‖. An exemplary case of PaaS is a virtual machine picture containing an arrangement of programming administrations (for instance, a Linux dissemination, a Web server, and a programming situation, for example, (PHP) so as to offer a web improvement condition for the Cloud designer. Some business cases from pertinent organizations in the IT field are now accessible. From the Microsoft, we have the Windows Azure Platform, while Google offers the Google App Engine. The Cloud engineer can utilize these stages to rearrange its usage procedure by depending on the arrangement of predefined devices offered by them. In spite of the fact that these stages can give a lot of adaptability, the constraint at this level is that the engineer is compelled by the functionalities offered through these stages.

2.3 Infrastructure as a Service (IaaS)

The IaaS benefit display is the most minimal administration demonstrate in the innovation stack, offering PC Infrastructure as an administration, for example, crude information stockpiling, handling force and system limit. The buyer can utilize IaaS based administration offerings to send his own working frameworks and applications, offering a more extensive assortment of organization potential outcomes for a shopper than the PaaS and SaaS models. The shopper does not oversee or control the hidden cloud foundation but rather has control over working frameworks; stockpiling, conveyed applications, and perhaps constrained control of select systems administration parts (e.g., have firewalls). A notable business item that offers arrangements at this level is the Amazon Elastic Compute Cloud or Amazon EC. This arrangement gives the client full access and control over the registering assets he paid for. This does not imply that the cloud client has control over the basic cloud texture, yet that he has control over a virtual machine, or an arrangement of assets, running over the Cloud texture controlled by the Cloud supplier. In this setting the cloud client is sans then to design their virtual machines with whichever arrangements he sees fit. This can be viewed as the layer where the level of flexibility of the client is the most astounding. At this layer the Cloud client still must be worried about keeping up the product he introduces in the assets leased to the Cloud supplier. Table-1 demonstrates the cloud administrations gave by a portion of the cloud suppliers.

Table-1: Cloud Services and Cloud Providers

Cloud Service Models	Cloud Providers
Software as a Service(SaaS)	Salesforce.com, Microsoft office 365, workday.
Platform as a Service(PaaS)	Google App. Engine, Force.com
Infrastructure as a Service(IaaS)	Amazon EC2, GoGrid, iCloud and Microsoft Azure DC.

III. BARRIERS TO CLOUD COMPUTING ADOPTION IN THE ENTERPRISE

In spite of the fact that there are many advantages to embracing distributed computing, there are likewise some critical obstructions to its appropriation. It is vital to at any rate get out what a portion of alternate hindrances to reception are

- Security
- Privacy
- Connectivity and Open Access
- Reliability
- Independence from CSPs
- Interoperability
- Economic Value
- IT Governance
- Changes in the IT Organization
- Political Issues Due to Global Boundaries

IV. ISSUES IN CLOUD COMPUTING

Cloud computing deals with various issues to maintain above discoursed characteristics and quality of serves assured to the user by cloud providers in term of high resource availability, computational capability. Some or the issues dealing with resource management, resource scheduling, and managing system performance are discoursed below.

- Resource allocation
- Load balancing
- Migration
- Power efficient resource allocation and load balancing algorithms
- Cost efficient resource allocation and load balancing algorithms
- Fault tolerant algorithms
- Behavior-based algorithms
- Trust management

4.1 Resource Allocation

Resource Allocation technique (RAS) in the cloud is about the booking of errands or demands by cloud supplier in such a way to adjust the heap over every one of the servers and give high caliber of Service to customers. It additionally incorporates the time required to allot the assets and the assets accessible. The primary point is to enhance the use of assets and finish the whole demand inside the due date and with slightest execution time.

4.2 Power efficient resource allocation and load balancing algorithms

The power efficiency of a cloud environment is an important issue for a green cloud environment. As 53% of the total expense of a datacenter is spend on cooling i.e. power consumption. In a survey in 2006 on datacenters established U.S consumed more than 1.4% of total power generated during the year. Therefore we require improving the power efficiency of infrastructure. The problem can be solved in various ways and various proposal are been made to solve and improve the performance. So to do this we need to design power-aware resource allocation and load balancing algorithm to improve the total power consumption of the system and any such algorithm will result in a reduction of overall power consumption.

4.3 Cost efficient resource allocation and load balancing algorithms

Cloud computing uses pay-per-use model to ensure least cost and payment only for the resources used. To maintain this feature cloud controller algorithms like resource allocation migration and load balancing are responsible for maintaining this characteristic by offering the resources which can complete the client request on time and within the budget of client and have least cost that can be offered. So we require cost aware algorithm which are cost efficient and can provide the best system performance by improving utilization and power consumption all at the same time. This type of algorithm are referred to as multi-objective algorithms, there are many proposals made for improving the performance of the system but they only take into consideration either power or cost, so cannot guarantee the best performance.

4.5 Fault tolerant algorithms

Cloud computing environment is a type of distributed environment like grid computing and cluster computing. Existing algorithms consider cloud as non faulty but faults are a part of distributed environment which may be due to hardware or software failure at any point of time. There are many fault aware and fault prediction algorithms been proposed for grid environment to improve the reliability of the system. So similarly we require fault aware algorithms to make system fault aware reduce the failure probability of the system and increase the reliability of the system.

V. RESEARCH PROBLEM

The aim of this research work is to make system fault tolerant and more reliable computing system with improved performance in cloud infrastructure environment. A number of algorithms have been worked out for long period of time but they assumed cloud as non-faulty. So in our work, we have proposed various fault tolerant algorithms to resolve various issues as follows:

(i) To design a fault and deadline aware load balancing algorithms for private and hybrid cloud, which aim to improve QoS of load balancing algorithm and minimize the faults, resource utilization, minimize response time and avoiding overloading of any single resource in cloud.
(ii) To design learning based fault aware resource allocation algorithms, to provide a global best schedule with least scheduling time complexity.
(iii) Designing fault aware and power-efficient scheduling algorithms for improving power efficiency and request failure count in the cloud.

VI. LITERATURE REVIEW

Our aims to identify the research gaps and focus on the current state of artwork in the field of resource allocation, load balancing, cost efficiency and green computing.

6.1 Resource Allocation

Many researchers have done research and introduce us some beneficial and optimal scheduling algorithm. [1] Proposed a modified Min-Min algorithm, this chooses the task with least completion time and schedule to serve accordingly. Author has proposed load balancing Min-Min algorithm which having basic properties of Min-Min algorithm and consider minimizing completion of all request. In this proposal three level of service models are used.

Request manager: To take request and forward to Service managers.
Service manager: various manger works or task and dispatch them to respective service node.
Service Node: Service node provide service to request which came to request mode

They have merged two approaches (OLB Opportunistic load balancing and load balance min-min) scheduling algorithms in this model. The main focus of combined approaches is to distribute the request or dispatched task basis of their completion time to suitable service node via an agent. This approach not saying about main system, suppose if request are somehow moving or scheduled in the same server and due to lots of load sever need more power to complete these request and more physical heat will generate and to stop heating system need an external cooling system which also lead to extra power source and one more important thing is due to overheating system performance slow down The same way [2] proposed and another algorithm for task scheduling, this paper proposed VM resource allocation basis on genetic algorithm to avoid dynamic VM migration to completion of request. They have proposed a strategy to share or allow resource equally to VM so it can work fast and minimize response time to subscribe. They also proposed hotspot memory (virtual memory) assignment and dispose that after completion of request via remapping of VM migration. Here VMware distribution tool is used to schedule computation work in a virtual environment. As genetic algorithm characteristics is to find best, fittest VM in terms of Cloud computation. This paper checks fitness of each VM and schedule task accordingly. When creating a VM a process executes to create that and increase process work that also lead to more process and increase energy consumption. Hu, Jinhua et al.[3] Proposed another scheduling algorithm, this paper proposed an approach for collective collaborative computing on trust model. The trust value taking as a factor for task scheduling, trust value mutually took from consumers as well service provider, which make it fail free execution environment. Here they have proposed a mathematical equation to calculate the Reputation point which enhances the reputation of VM in terms of fast execution and type of task. If the reputation of VM is high them more task allocation will be happening to that VM. To calculate Reputation many factors have to consider which also reflect QoS of cloud computing. This paper also proposed a way to serve a request reliability, as well trust management with a reputation of VM factor which are lead to trustworthy. Trust has calculated by a mathematical equation and schedule accordingly.

Hu, Jinhua et al. [4] proposed a live VM migration algorithm, this paper proposed a method for VM live migration with various resource reservation system. VM migration is taking place on the basis of source machine load, if the load is high then it can wear, during execution of the request it migrates the VM to another server or data centers to complete the task without interruption for better performance. Resource reservation done both sides, i.e., Source machine and target machine as well will in such manner CAP (maximum availability of CPU) allocate them and adjust memory resource dynamically. At the end of target machine, they properties time bound program which will keep monitoring for cup resource utilization. Memory Reservation done by allocating crating certain number of VM and when the migration process comes into existence these VM got shut down to evacuate the space to migrate VM. Sometime it may be possible that target machine not having enough space to migrate in such condition that physical machine should remove from candidate machine for migration and which physical machine having the capability or enough space will lead to migrate VM. This paper implemented and simulated using Xen Virtualization.

Barroso et al.[5] This paper proposed an algorithm, dynamic and integrated resource scheduling algorithm for cloud data center which balance load between servers in overall run time of request, here they are migrating an application from one data center to another without interruption. Here they are introducing some measurement to ensure load balancing. They have given a mathematical reputation to calculate imbalance load to calculate average utilization to its threshold value to balance load. To implement DAIRS they have used physical server with physical cluster and Virtual servers with virtual cluster. Application migration saves time instead of migrating whole VM data. Zhanjie Wang [6] proposed an dynamic algorithm for resource allocation in cloud using fuzzy logic and pattern recognition based on power and storage parameters. The propose algorithm is derived from FastBid algorithm. The algorithm tries to improve the network traffic and communication load over the system. The algorithm shows better result than Min-Min algorithm in term of makespan and network load

Parvathy S. Pillai [7] et al. proposed a novel resource allocation algorithm derived from game theory for resource allocation in cloud. In this work author has used uncertainty principle of game theory for allocation of virtual machines in cloud. This work improves the communication cost and resource wastage over the system. Abdullah Yousafzai [8] et al. surveyed and reviewed resource allocation algorithm in cloud. This work contributed an review and comparative study or current state of art cloud resource scheduling and allocation algorithms for cloud. Moreover this article proposes an taxonomy for resource allocation in cloud environment, which shows various ways to solve the issue of resource allocation and different aspects of resource allocation. Figure given below shows the taxonomy. Many other resource allocation algorithm are been proposed using various dynamic techniques to improve the performance of the system are been studied.

6.2 Power Efficient Algorithms

Louis Rilling et al. [9] proposed a virtual infrastructure optimization solution using the ant colony optimization algorithm for finding better paths through graphs. The most common approach while performing workload consolidation is that the workload is allotted to a physical machine (e.g. CPU) and those resources which require excessive provisioning are converted into a lower power state. Osvaldo Adilson de Carvalho Junior et al. proposes the use of a function that can ensure the most appropriate behaviour to the principles of Green IT but not the quality of service. For this he proposes the use of GreenMACC (Meta-scheduling Green Architecture) and its module LRAM (Local Resource Allocation Manager) to automate the execution of all scheduling policies implemented in the Scheduling Policies Module so as to provide Quality of Service in Cloud Computing and determine its flexibility. [10] Task consolidation is an efficient method which is used to reduce power consumption by increasing the resource utilization but due to task consolidation resources may still draw power while being in the idle state. Young Choon Lee et al. has introduced two algorithms to maximize the utilization of resources of the cloud. The two algorithms are ECTC and MaxUtil. ECTC works on the premise of calculating the energy which is being used by a particular task when there are simultaneous tasks running parallel with it, and then it is compared with the optimal energy which is required. MaxUtil focuses more on the mean usage of a particular task when it is being processed.

Dzmitry Kliazovich et al. presented a simulation environment for data centers to improve their utilization of resources. Apart from working on the distribution of the tasks, it also focuses on the energy used by the data center components. The simulation outcomes are obtained for various architectures of data centers. In [11] Robert Basmadjian et al. proposed the use of proper optimization policies reducing the power usage and increasing the resource utilization without sacrificing the SLAs. He developed a model which worked on incrementing the capability of the processor to process tasks. [12] Zhou Zhou et al proposes a Three Threshold Energy Saving Algorithm [TESA] which has three thresholds to divide hosts between heavy load, light load & middling load. Then based on TESA 5 VM migration policies are suggested which significantly improves energy efficiency.

6.3 Cost Efficient Algorithms

Li Chunlin et al. [13] proposed and const and energy aware resource provisioning algorithm for cloud. This paper presents the cost and energy aware service provisioning scheme for mobile client in mobile cloud. Proposed work proves to be cost optimal and energy efficient as compares to simply cost aware allocation algorithms. Ehsan Ahvar et al. [14] has proposed an network aware cost optimal algorithm. This algorithm takes into consideration network performance and cost for resource allocation and selection of best server, using artificial algorithm to perform better than typical greedy heuristics. Khaled Metwally et al. proposed a Mathematical modeling based on Integer Linear Programming (ILP) technique to solve optimally the resource allocation problem. However, ILP technique is knows for solving well known problem of scheduling in operating system. Author has proposed a model to use linear programming for selection of appropriate resource. Balaji Palanisamy et al. [15] proposed a cost aware allocation algorithm for MapReduce in cloud. This article presents a new MapReduce service model for cloud named Cura. Cura is cost efficient MapReduce model and cloud service to select the resource at run time for distributed problem with least cost and most efficient resource. Cura is also responsible for creation and selecting of cluster for dealing with workload. It also includes, VM-aware scheduling and online virtual machine reconfiguration, for better management and reconfiguration resources.

6.4 Trust Models

Numerous trust models have been proposed in cloud. MohdaIzua Mohd Saad proposed a novel data provenance trusted model to provide secured access to data provenance via a secured communication channel [63]. This model also proposes consolidation storage with logging for virtual storage at physical layer in cloud environment. As shown in Figure-2.

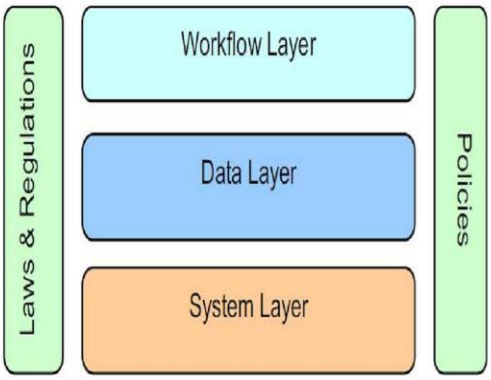

Figure-2 : The trust cloud framework.

WenAn Tan proposed a trust service-oriented workflow scheduling algorithm [16]. The scheduling algorithm uses a trust metric that is combination of direct trust and recommendation trust. Proposed model also provided balancing policy to balance user requests, based on time, cost, and trust. Rizwana A.R. Shaikh proposes a trust based solution in terms of a trust model that can be used to calculate the security strength of a particular cloud service. Proposed algorithm uses trust value for selecting a trusted cloud service. Xiaodong Sun introduces a trust management model based on fuzzy set theory and named TMFC including direct trust measurement and computing, connecting, and trust chain incorporating where the issue of recommended trust has been addressed to find the miss behavior of intermediate middle nodes. And this proposed model is designed for the cloud users to make decision on whether to use the services of some cloud computing providers by using trust value sets about providers and then finding trust relationships among them.

QiangGuo introduced a definition of trust in cloud systems and the properties of trust are analyzed. Based on the properties of trust of a server, a trust evaluation model called ETEC is proposed. Proposed trust model includes a time based comprehensive evaluation method for calculation of direct trust and a space evaluation method for calculating recommendation trust of server. For computing the trust in cloud, an algorithm based on the trust model is given. Experimental analysis shows that the proposed model can calculate the trust vale of server effectively and reasonably in cloud computing environments. Xiaoqiong Yang also proposed A Statistical User-Behavior Trust Evaluation Algorithm Based on Cloud Model for statistic behaviors. Proposed algorithm used threshold for each type of behaviors and each user's performance and its membership status in cloud. Then the membership degree and the behavior weight will be used to calculate the user's trust using a simple normalization function. Proposed algorithm uses the evaluated domain trust and recommendation trust, behavior trust for users' further dynamic authorization of access control and request load balancing. Junfeng Tian proposed a Trusted Control Model of Cloud Storage with access control (TCMCS) to handle all the interactions between a client and cloud storage to ensure the secure user access and data manipulation. The proposed trust model is responsible for managing different cloud storage and manages security and integrity of user data over the cloud. Since users only need to care about their own business logic and the development of application program is greatly simplified. Proposed model can be specified as shown in Figure-3.

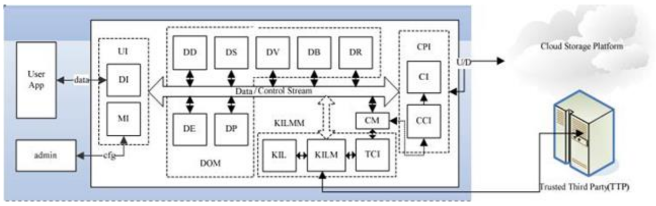

Figure-3: The logical structure diagram of TCMCS

In [17] gupta has proposed a QoS Based Trust Management Model for Cloud IaaS that is suitable for trust value management for the cloud IaaS parameters. Proposed a scheduling algorithm based on trust value is done for better resources allocation and enhance the QoS provided to the users. In this paper, an approach for managing trust in Cloud IaaS is proposed.

VII. CONCLUSION

From above discussion, we can seen that various resource allocation and load balancing algorithms fall short with problem of request scheduling using dynamic techniques to improve the performance of system. These algorithms do not consider load over the system or faults that may occur periodically over system, and also lack into consideration of previous performance history of the machines/servers. Various load balancing algorithms are discoursed but these proposals consider only current load over the servers and do not search for global solution that can be based on performance of the server. These algorithms have considered only the current performance and not the physical capability of servers. Moreover, existing load balancing algorithms have assumed system as non faulty that leads to a large number of faults over the system. In energy and cost efficient allocation and load balancing algorithms for cloud but they are not suitable for real-time systems because they do not take into consideration physical aspects of servers, deadline of requests, and considers cloud as non-faulty. So proves to provide poor performance for request with tight deadline and if the system is faulty in nature i.e. the server may have high capability in terms of number of cores and RAM but may be faulty in nature, in that case existing algorithm goes under worst case performance. These algorithms also do not provide support for the reliability of the distributed systems.

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