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Load Balancing in Cloud

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Abstract- Proposed work states the load balancing concept in cloud. Instead of partitioning a file into a no. of chunks and balancing a load by migrating different chunks to different chunk servers, here a Load Balance Nearest Search Algorithm is presented to cope with the load imbalance problem. In this it migrates one user's one whole file into any one nearest node. Load is transferred from heavily loaded node to physically closed lightly loaded node. The proposed work strives to balance the loads of nodes and reduce the demanded movement cost with reduce spending on technology as much as possible.

Keywords- Load balancing, cloud, Load Balance Nearest Search Algorithm, chunks, threshold .

INTRODUCTION

Load balancing is essential for efficient operations in distributed environments. It means distributing the amount of work to do between different servers in order to get more work done in the same amount of time and serve clients faster [41].

The definition of cloud computing provided by National Institute of Standards and Technology (NIST) says that: "Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, data storage, software applications and other computing services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [42].
The main advantages of the cloud computing are the following:

- There is no need to download or install specific software
- The cost is low or even free, in some cases;
- If the client computer crashes, there is almost nothing lost because everything is stored into the cloud
- There is no need to update the local system when some new fix packs are released
- Cloud computing can be used on clients having minimal hardware requirements like mobile phones or PDAs;
- The problem of licensing different software packages is moved to the data center level
- No costs (or very small ones) for hardware upgrades;
- The users are not dependent by their personal computer because they can use any other device having an Internet connection and minimum software requirements.

LITERATURE REVIEW

Many algorithms have been proposed previously for load balancing. Some of those algorithms are as follows.

Paper [1] proposed load rebalancing for distributed file systems in clouds which is comparable with the existing centralized approach and considerably outperforms the prior distributed algorithm in terms of load imbalance factor, movement cost, and algorithmic overhead. A load rebalancing algorithm is used to reallocate file chunks such that the chunks can be distributed to the system as uniformly as possible while reducing the movement cost as much as possible. Here, the movement cost is defined as the number of chunks migrated to balance the loads of the chunk servers.

A proximity-aware load balancing scheme is discussed by using the concept of virtual servers. The goals of this scheme are not only to ensure fair load distribution over nodes proportional to their capacities, but also to minimize the load balancing cost by transferring loads between heavily loaded nodes and lightly loaded nodes in a proximity-aware fashion. This ensures a fair load distribution among nodes i.e. nodes carry loads proportional to their capacities [2].

In [3], a histogram manager maintains a histogram that reflects a global view of the distribution of the load in the system, and a load-balancing manager that redistributes the load whenever the node becomes overloaded or underloaded. Advantage of this paper is that it reduces the cost of constructing histogram, reduce the cost of maintaining histogram and reduce the cost of updating histogram.

Paper [4] mainly concerns with the load balancing of cloud datacenters to improve efficiency of the host machine and minimize number of active host machine to support green computing concept. Author introduces a threshold based Dynamic compares and balance algorithm (DCABA) for cloud server optimization. This paper has shown the applicability of load balancing and server consolidation techniques to obtain measurable improvements in server workload management and minimize the cost of cloud services.

In [5], load balancing of nodes in cloud using Ant Colony Optimization algorithm described the example of an ant that how ant care for every node they visit and record their data for future decision making. This efficiently distributes the load among the nodes such that the ants never encounter a dead end for movements to nodes for building an optimum solution set.

A Load Balancing Ant Colony Optimization algorithm in [6], found the optimal resource allocation for each task in the dynamic cloud system. LBACO algorithm is to balance the entire system load while trying to minimizing the make span of a given tasks set.

The analysis of three contemporary algorithms in [7] namely Round Robin, Equally Spread Current Execution Load (ESCE), Throttled Load Balancing in cloud analyst tool to resolve the issue of cloud load balancing as a preparation phase for new load balancing technique. This helps to enhance the overall cloud performance. This paper proposed a new VM load balancing algorithm: Weighted Signature based Load Balancing (WSLB) algorithm proposed to minimize the users response time.

A hybrid control strategy for load balancing in [8] presents the storage node cluster redistributes the load in its local range. On the other hand the system applies the overlapping structure to distribute the load to the global storage nodes by batch iteration approach. The local applies the centralized control strategy to quickly redistribute the load.

In [9], author proposes some common load-balancing tactics, which include: round-robin, weighted round-robin, least-connection, weighted least connection and shortest expected delay. Round-robin dispatches workloads to servers with an even occurrence. Resource-fit best dispatches a workload to the most resourceful server at a moment in the farm.

In [10], authors ensure that one chunk of a file and its two copies are stored in three different chunk servers at the same time. A load rebalancing algorithm not only achieves load balancing but also ensures the high reliability of the system.

The Central Load Balancer (CLB) in [11], is connected to all users and virtual machines present in cloud data center through Data center Controller. Load balancing helps to achieve a high user satisfaction and resource utilization ratio by ensuring an efficient and fair allocation of every computing resource, minimizing resource consumption, implementing fail-over, enabling scalability, avoiding bottlenecks and over-provisioning etc. The Central Load Balancer (CLB) manages load distribution among various virtual machines and assigns load corresponding to their priority and states. In this way this technique efficiently shares the load of user requests among various virtual machines.

In [12], authors proposed a comparative study between the three load balancing architectures in cloud computing: centralized, decentralized and hierarchical load balancers. Among the critical factor that affects the performance of a load balancer is its architecture which can be decentralized, centralized or hierarchical.

A novel decentralized load balancing architecture, called tldlb (two-level decentralized load balancer). Advantage of this is decentralized architecture for providing scalability and high availability capabilities to service more cloud users. This proposed a novel neural network-based load balancing algorithm, nn-dwrr, to distribute incoming requests to appropriate VMs [13].

In paper [14], The Benefits of Estimated Global Information in DHT Load Balancing reduces the network traffic induced by load balancing while achieving a better load balance than standard algorithms. Load balancing algorithms have two goals: (a) improving the load distribution fairness and (b) minimizing the data moved around for achieving the first goal. This shows the benefits of adding global estimates for both, active and passive load balancing algorithms.

The basic idea of hierarchical strategy in [15] is to divide processors into independent autonomous groups and to organize the groups in a hierarchy, thereby decentralizing the load balancing task. This deal with scalability challenges of load balancing at very large scale reduces the time and memory required for load balancing.

In [16], Cygnus has an ability to make load balancing decisions based on application defined load metrics, dynamically (re)configure load balancing strategies at run-time. Cygnus provides a framework for integrating strategies such as Round Robin, Random, Least Loaded, and Load Minimum to help increase overall system scalability.

In [17], authors focused on dynamical discrete-time load balancing in distributed systems in the presence of time delays with the double load-balancing strategy the overall completion time is further reduced in comparison to the single load balancing case. Load-transfer delays are negligible and the time required to implement the load balancing policy is also negligible so the best performance is obtained.

A new threshold load balancing method for workstations [18], decides a periodic time to perform load balancing. It performs load balancing with a long fixed period regardless of what the value of the average idle-time to avoid the load balancing overheads

In [19], parallel hybrid dataflow architecture is a scalable dynamic load balancing circuit for the proposed architecture and performance analysis. Here focus was on presenting the framework of the proposed HDCA system, the modeling, design, and performance of a "basic" and then "modular" (scalable) dynamic load balancing circuit for a HDCA type computer system.

Some of the algorithms about load balancing for distributed file system have been proposed previously. These are as follows.

Load rebalancing algorithm in [20], implemented so that central node should not overload. The implementation is done in Hadoop distributed file system. As apache Hadoop is used, security issues are arises. To solve security issues and to increase security, Kerberos authentication protocol is implemented to handle multiple nodes. As Hadoop's use and demand grew in the network, handle big data security became critical, so that authentication mechanism Kerberos is used.

In [21], authors illustrate and define the load rebalancing problem in cloud DFSs. They advocate file systems in clouds shall incorporate decentralized load rebalancing algorithms to eliminate the performance bottleneck and the single point of failure.

In order to avoid the system burden caused by duplicate data in [22] proposes novel data center management architecture: Index Name Server (INS), which integrates deduplication and access point selection optimization techniques to enhance the performance of the cloud storage system. INS improves the efficiency of the cloud storage system. The proposed INS data center management mechanism omits the scanning procedure of traditional backup and decreases the backup cost and establish efficient backup of all schemes and methods.

In [23], it combined with greedy algorithm; the scheme provides a better load balancing algorithm for different load cases (CLB). CLB algorithm utilizes entropy and the scope of invalid cache invalid as the evaluation basis of load balancing effect. Authors proposed effect of load balancing and the scope of invalid cache. Cache-invalidation-scope model is established to improve the effect of load balancing.

In [24], authors proposed two novel brownout-aware load balancing algorithms. To test their practical applicability, they extended the popular lighted web server and load-balancer, thus obtaining a production-ready implementation. This paper presents a novel approach for improving resilience, the ability to hide failures, in cloud services using a combination of brownout and load-balancing algorithms.

A load balanced co-location algorithm in [25] is incorporated into CoHadoop++ which balance the load in cluster through optimal selection of data nodes based their load. CoHadoop++ ensures that the fault tolerance property of Hadoop is not compromised, when excluding nodes from the node selection policy.

In [26], a novel data partitioning and selective replication method utilizes the temporal information in prior workloads to predict future query patterns. This approach performs partitioning and replication simultaneously to reduce the number of servers processing queries while respecting load balancing and I/O load constraints under replication.

Policy-based security framework in [27] is highly evolving and dynamic for securely outsourcing enterprise data and computations. Instead of using several storage nodes or several computation nodes in the same CSP, multiple CSPs can be used for to increase reliability of the whole system.

Cost Minimization for Big Data Processing in Geo-Distributed Data Centers deals with big data processing in geo-distributed data centers jointly consider data placement, task assignment and data flow routing in a systematical way. This paper jointly studies the data placement, task assignment, data center resizing and routing to minimize the overall operational cost in large-scale geo-distributed data centers for big data applications [28].

As stated in [29], Chord maintains its routing information as nodes join and leave the system. Valuable for cooperative file sharing, time-shared available storage systems, and distributed indices for document and service discovery, and large-scale distributed computing platforms.

In [30], author proposed a new model for distributed load balancing allocation of virtual machine in cloud data center using the TOPSIS find the most suitable PM in the data center for the migrated VMs. Each node in the data center runs a module of the VM monitor which observes the local resource usages of the node.

In [31], authors discussed the future of content distribution among mobile devices forming mobile clouds. The future of mobile clouds is in novel in order to boost cooperation among users and connect people over the shared content.

In [32], with SDN, program the virtual switches at the physical servers so as to meet all those requirements, without demanding special hardware in the network. The abstraction of the SDN provides a logically centralized location where network configuration and control can be performed easily, while maintaining the scalability of the solution.

A framework for designing energy efficient cloud computing services over non-bypass IP/WDM core networks in [33] replicate content into multiple clouds based on content popularity yields 43% total saving in power consumption compared to power un-aware centralized content delivery.

In [34], author's asynchrony introduces security challenges which prevent information leakage not only through access patterns but also through timing of I/O events. Also proposes various practical optimizations which are key to achieving high performance and techniques for a data center to dynamically scale up a distributed ORAM.

PiCsMu in [35] aggregates multiple Cloud storage services, provides enhanced privacy and offers a distributed file sharing system. The work is to show the feasibility to store arbitrary data in different Cloud services for private use and/or for file sharing.

Software defined radio-based architecture that addresses problems and can be implemented on a cloud of general purpose computing platforms. Cloud-RAN can be implemented on general purpose processor and an off-the shelf software-defined radio front-end connected over commodity LAN network [36].

Objective of [37] is to maximize the system throughput, for which first proposes a novel admission cost model then devise efficient control algorithms and finally conduct experiments on proposed algorithms. It developed novel admission control algorithms through proposing novel admission cost model to model different resource consumptions.

The major purpose of [38] was to examine the cloud services pricing schemes and how they can improve previous pricing models by expanding the consumer set with time inconsistent behavior. A simple model of hyperbolic discounting function improved by including a more sophisticated form of hyperbolic discounting function where the model has impact of network externalities on consumers' utility function.

The Future of Cloud-Based Entertainment is about the future of cloud-based entertainment. Major portions of personal time and experience are being rendered, stored, or mediated in the cloud. Augmented reality can follow you on display surfaces throughout the home, such as walls, windows, mirrors, appliances, tablets, and tables [39].

Power Metering for Virtual Machine in Cloud Computing Challenges and Opportunities [40] makes a comprehensive investigation in issues regarding VM power metering, including server models, sampling, V=M power metering methods and the accuracy of the methods. Investigation regarding issues of VM power metering focused on estimating VM power at the software level, tools for information collection, modeling methods, and estimation.

PROBLEM FORMULATION

Analysis

In this stage an in-depth analysis is performed to obtain a detailed understanding of the business needs as defined in the business case and scope documents.

By analyzing previous algorithms where files and nodes can be created, deleted and appended. This results in load imbalance in distributed file system. To solve this issue I have developed logic on logical platform.

Problem Definition

The aim is to develop an approach for load balancing in cloud. A load balancing algorithm is proposed to cope with the load imbalance problem. Instead of partitioning a file into a no. of chunks and balancing a load by migrating different chunks to different chunk servers, the Load Balance Nearest Node Search Algorithm migrate one user's one whole file into any one nearest node. For this, the time complexity of manipulating of hash addresses to keep track of these file chunks are avoided. By doing this, it eliminates previous time consuming procedure.

Higher capacity nodes carry more loads. Load is transferred from heavily loaded node to physically closed lightly loaded node. This method balances the load when it reaches to threshold/control line only. Where it treats the overloaded portion above the threshold line and underloaded portion as below the load control line i.e. threshold line.

[Step 1- step 5: Load Balance Nearest Node Search Algorithm]

Step 1: For i=1 till i<=5 do i++
If nearest node's load is below the threshold line and Node remaining storage capacity >= User trying to upload file capacity
Then upload file. Go to step 11.

Step 2: For i=1 till i<=5 do i++
If nearest node remaining storage capacity >= User trying to upload file capacity
Then upload file. Go to step 11.

Step 3: X=Total no of nodes in cloud
For i=6 till i<=X do i++
If Empty nodes available and Node storage capacity >= User trying to upload file capacity
Then upload file. Go to step 11.

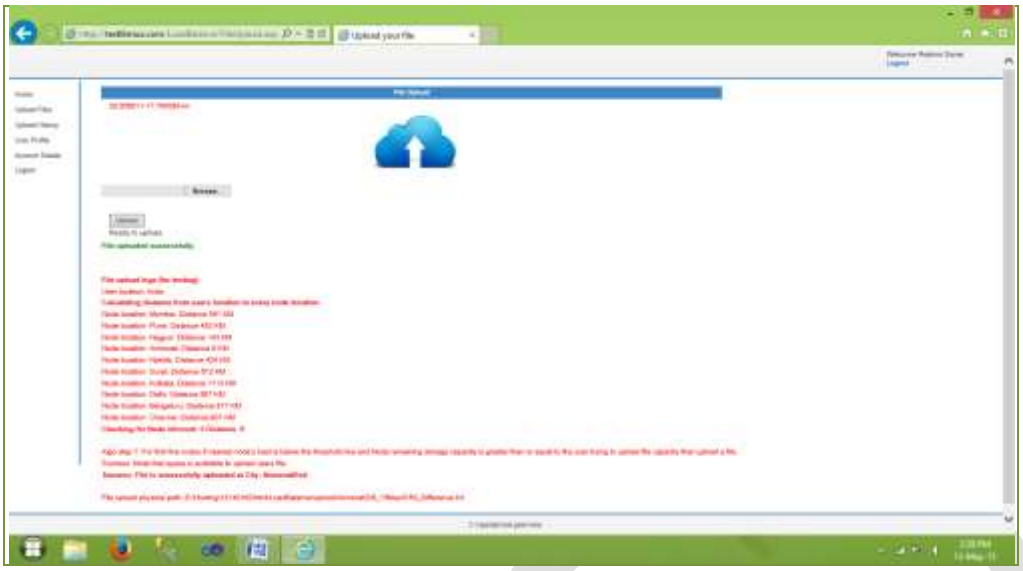
Step 4: For i=6 till i<=X do i++
If nearest node remaining storage capacity >= User trying to upload file capacity
Then upload file.

Step 5: Exit

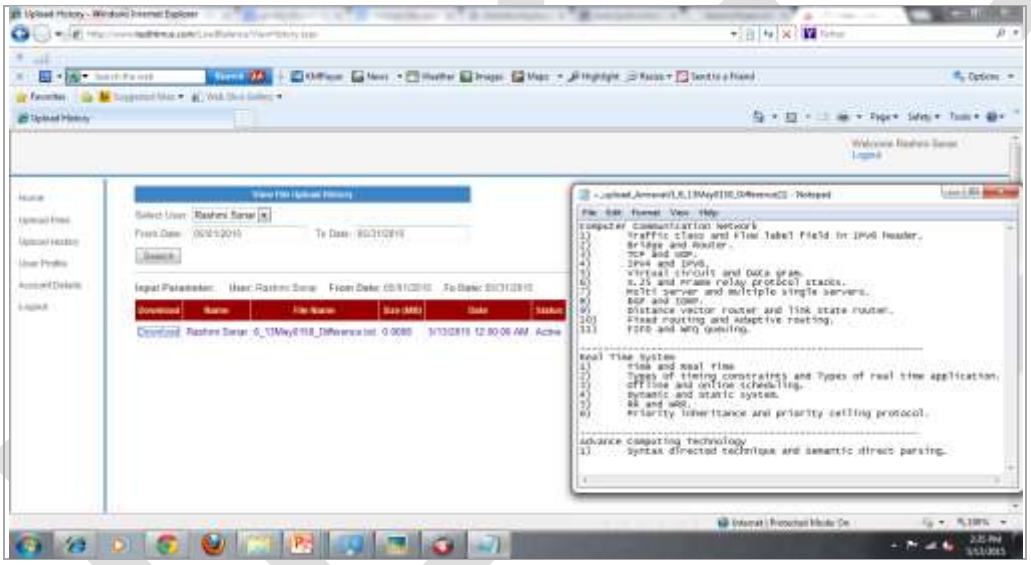
RESULT

The proposed approach is working as an infrastructure-as-a-service in cloud experimental environment. It balances loads of nodes while uploading a file by redirecting requests of various users according to their current location to physically closed lightly loaded node by calculating shortest distance among all available nodes using Load Balance Nearest Node Search Algorithm which checks respective node's threshold by which propose system reduces the demanded movement cost. As user can access cloud service of file storage i.e. uploading a file and downloading a file from any location, system verify the steps of algorithm and store a file for valid user. If the same user accesses the storage-as-a-service from different location and or different cloud client then again it will check the steps of algorithm and according to current location his different files will distribute to different nodes. As per user request, the file get upload on shortest distance node by redirecting to respective node location.

If we host the servers at various locations then the same proposed approach will be applicable. The node path which differentiates between proposed approach and real time cloud. Here, as we are using a cloud environment logically, in logical environment, file get uploaded to respective node directory by directory path where in real time environment file will get redirected to actual server only by its IP address instead of directory path.



Screenshot 1: Upload a file from system1



Screenshot 2: Download a file from system2

EXPERIMENTAL DISCUSSION & RESULT

For first five nodes if nearest node's load is below the threshold line and Node remaining storage capacity is greater than or equal to the user trying to upload file capacity then upload a file.

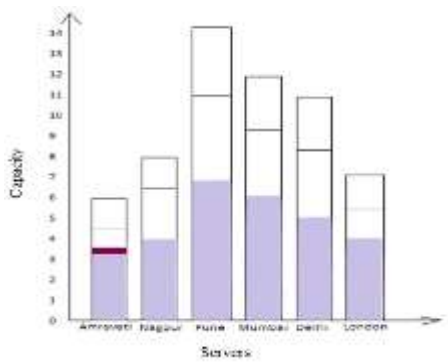


Fig 1: Load balanced when uploads a file below threshold

For first five nodes if nearest node remaining storage capacity greater than or equal to the user trying to upload file capacity then upload a file.

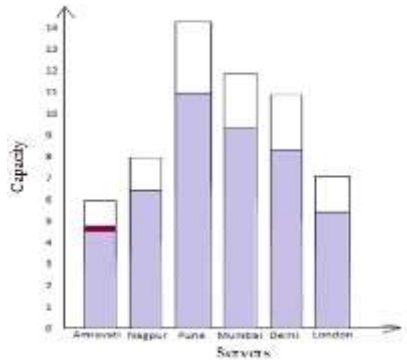


Fig 2: Load balanced when uploads a file above threshold

From all rest nodes if empty node available and node's storage capacity is greater than or equal to the user trying to upload file capacity then upload a file.

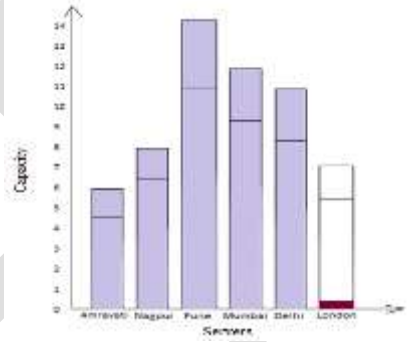


Fig 3: Load balanced on empty node

From all rest nodes if nearest node remaining storage capacity is greater than or equal to the user trying to upload file capacity then upload a file.

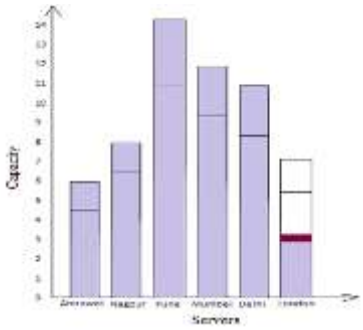


Fig 4: Load balanced on nearest node

Following table shows the difference between existing approach and proposed approach:

Sr. No.	Existing approach	Proposed approach
1.	Cloud partitions a file into a large no. of disjointed and fixed-sized pieces	Load Balance Nearest Node Search algorithm migrates one user's one whole file into any one nearest node.
2.	File chunks are not distributed as uniformly as possible among the nodes.	Removed the concept of file chunks.
3.	Manipulate hash addresses to keep track of file chunks	Time complexity of manipulating of hash addresses to keep track of file chunks are avoided
4.	Time consuming procedure.	Performance improved approach.
5.	Periodically checks for balancing a load.	Balances the load by comparing to threshold/control line only.

Table 1: Difference between existing approach and proposed approach

CONCLUSION

The proposed work strives to balance the loads of nodes by Load Balance Nearest Node Search algorithm which migrates one user file into any one nearest node. This is a performance improved approach which reduces the demanded movement cost as much as possible, maximized the throughput and minimized the response time. In experimental platform, we have implemented web based application where load is balanced for logical cloud.

FUTURE SCOPE

Energy efficiency has become one of the most active topics in large scale of data center or cloud computing environment today. In future work, we can create a group of the nodes which are underutilized by 25% and computing load in a single server which should be less than 75% or specified threshold control line for Green Computing.

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