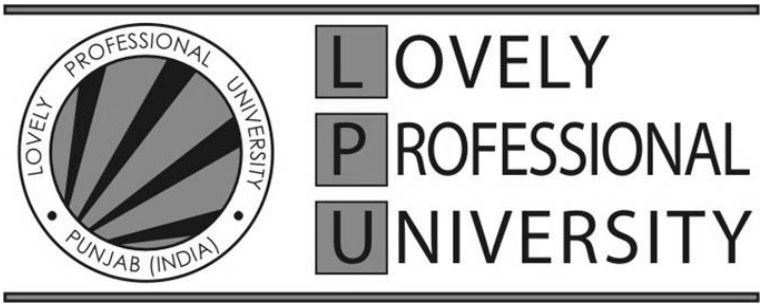

EXTENDED VMBUDDIES USING MAPREDUCE FOR LIVE MIGRATION OF MULTI-TIER APPLICATIONS IN CLOUD COMPUTING

A Dissertation submitted

By PREETJOT SINGH
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To

Department of Computer Science and Engineering

In partial fulfilment of the Requirement for the

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Master of Technology in Computer Science Engineering

Under the guidance of

Mrs. AVINASH KAUR

(Assistant Professor)

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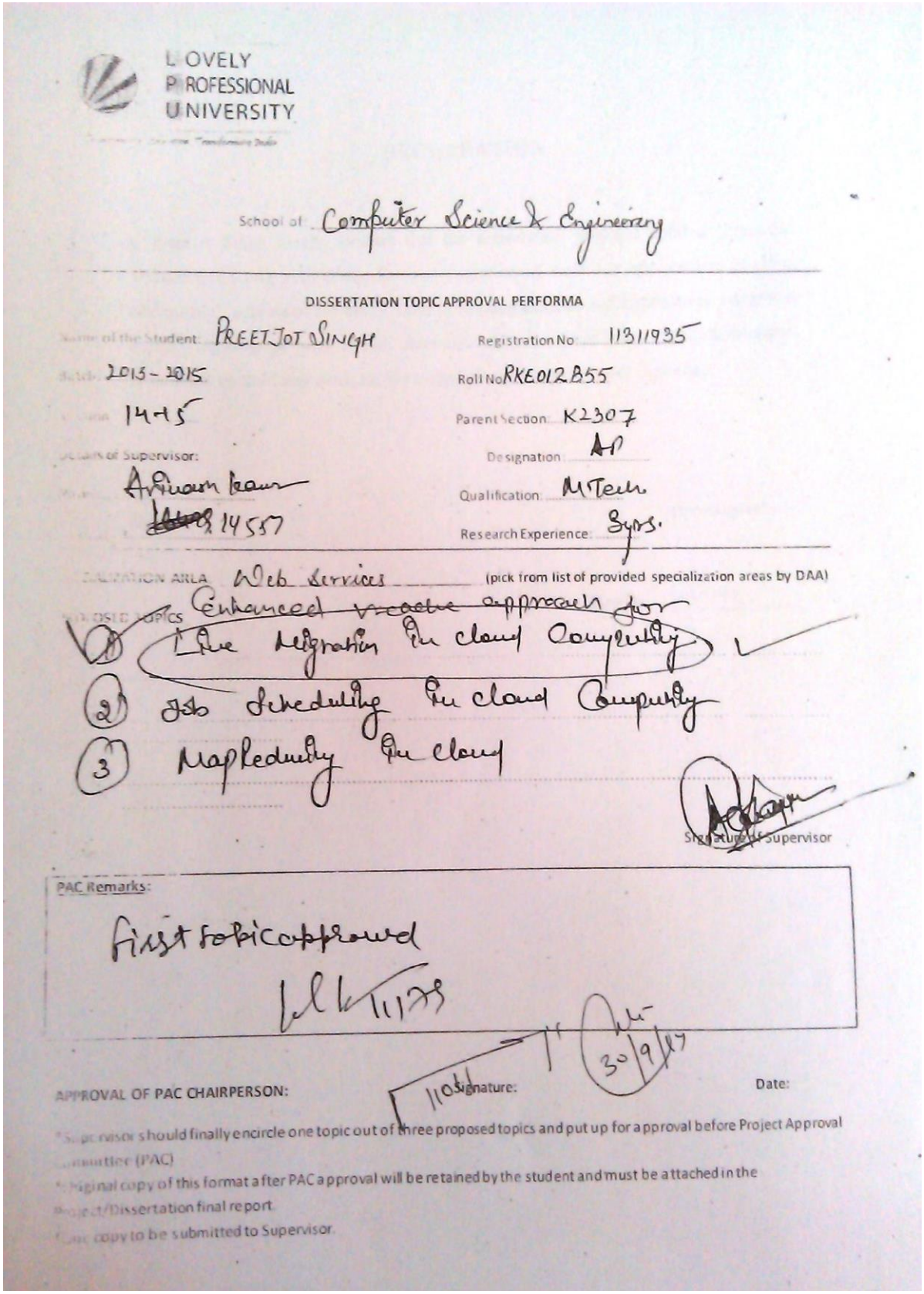
PAC FORM



LOVELY PROFESSIONAL UNIVERSITY

School of Computer Science & Engineering

DISSERTATION TOPIC APPROVAL PERFORMA

Name of the Student: PREETJOT SINGH Registration No: 11311935

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SPECIALIZATION AREA: Web Services (pick from list of provided specialization areas by DAA)

PROPOSED TOPICS

1. ~~Enhanced reactive approach for~~ Live Migration on cloud Computing
2. Job Scheduling on cloud Computing
3. MapReduce on cloud

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*Supervisor should finally encircle one topic out of three proposed topics and put up for approval before Project Approval Committee (PAC)

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ABSTRACT

Recent studies have been focusing upon power consumption and the service quality in cloud computing. The studies to examine various available solutions to improve these problems, providing mechanisms to support migration over multiple clouds. With the increasing use of cloud computing over internet, performance and cost of virtual machines while migration in the various applications is of the most concern. Managing the performance of single virtual machine migration is simple but for geographical data centres, managing the migration cost and performance of live migration of multi-tier application is important and different from it. Live migration have been performed by single VM migration but perfoming in clustered data centers has been a challenging tasks. Live migration of virtual machines for multi-tier applications need better performance in less migration time. So VMbuddies have been already implemented for the purpose. But we have further enhanced the working of the VMbuddies by introducing a MapReduce technique in the synchronization protocol of VMBuddies that will synchronize the different applications to reach their destinations along with more reduction in transfer cost and a network bandwidth allocation protocol that too improves the migration cost and this saves the migration time ahead in a better and effective way. The aim of the research is to get the migration cost reduced with which an effective response time of migration is generated that saves the cost of retransmitting the page dirtied while migration. This will help to make virtual machines more efficient in an optimized way.

ACKNOWLEDGEMENTS

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I express my gratitude to my parents for being a continuous source of encouragement and for their financial aids given to me. Finally, I would like to express my gratitude to all those who helped and supported me

CERTIFICATION

This is to certify that Preetjot Singh has completed M.Tech dissertation titled **"Extended VMBuddies using MapReduce for Live Migration of Multi-tier applications in Cloud Computing"** under my guidance and supervision. To the best of my knowledge, the present work is the result of her original investigation and study. No part of the dissertation has ever been submitted for any other degree or diploma.

The dissertation is fit for the submission and the partial fulfillment of the conditions for the award of M.Tech Computer Science & Engg.

Date: Signature of Advisor

Name: Avinash kaur

DECLARATION

I, Preetjot Singh hereby declare that the dissertation proposal entitled **'Extended VMbuddies using mapreduce for live migration of multi-tier applications in cloud computing'**, submitted for the M.Tech (Computer Science and Engineering) degree is entirely my original work and all ideas and references have been duly acknowledged. It does not contain any work for the award of any other degree or diploma.

Date: **Investigator**

Reg No._____

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LIST OF ABBREVIATIONS

SNO.	ABBREVIATIONS	FULL FORM
1	VM	Virtual Machine
2	IaaS	Infrastructure as a service
3	PaaS	Platform as a service
4	SaaS	Software as a service
5	DSB	Dynamic Self Ballooning
6	WAN	Wide Area Network
7	SSA	Slow Scheduling Algorithm
8	SOA	Service Oriented Architecture
9	XGE	Xen Grid Engine
10	IP	Internet Protocol
11	LAN	Local Area Network
12	ViNe	Virtual Network
13	NBD	Network Block Device

CHAPTER 1

INTRODUCTION

1.1 CLOUD COMPUTING

The word “cloud” means internet. Cloud computing is an internet based service. Its also called as pay-as-you-go service which means that the users can use a service or application on internet without downloading it or without paying for it completely. They only have to pay for how much they have used. Cloud computing depends on on the computer resource sharing than personally handling devices or applications or local servers. It is similar to grid computing. In grid computing, every computers unused process cycles are connected to solve problem that are too rigorous for any stand alone device [15].

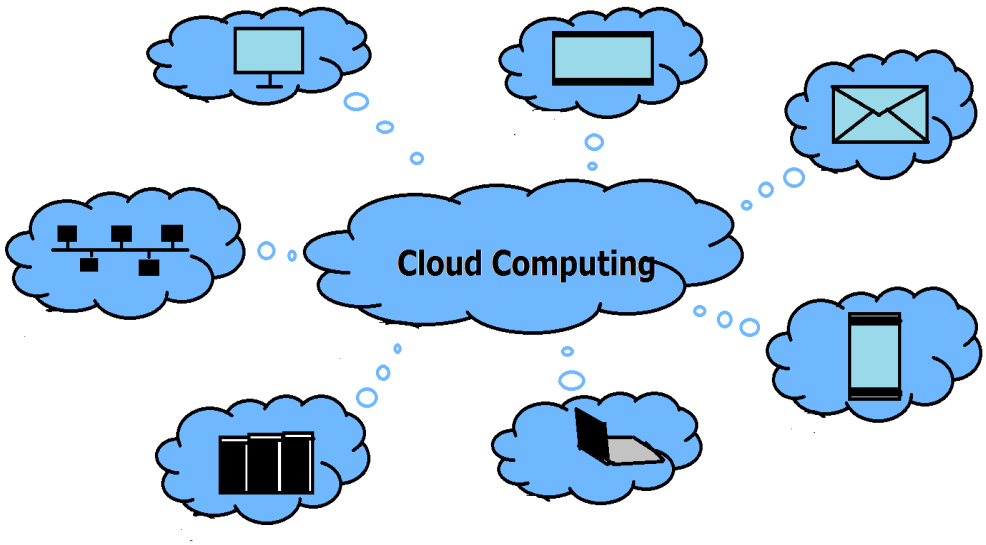


Fig. 1.1 cloud computing environment

Cloud computing is usually applicable in military and research fields. Its aim is to provide a high performance of computing power. This is done by connecting a large cluster of servers on the network that run a minimum cost PC technology that has special connections for spreading data process chores through them [16]. Virtualisation increases the cloud computing power. IBM offered a cloud computing system that is based on open source and open standard software that delivers web 2.0 capabilities by connecting all the computers together and this technology is called as “Blue Cloud”. Small businesses by

using cloud computing can these resources accessed and may use them to shrink or increase their business. They only have to pay for what and how much they have used a service [16].

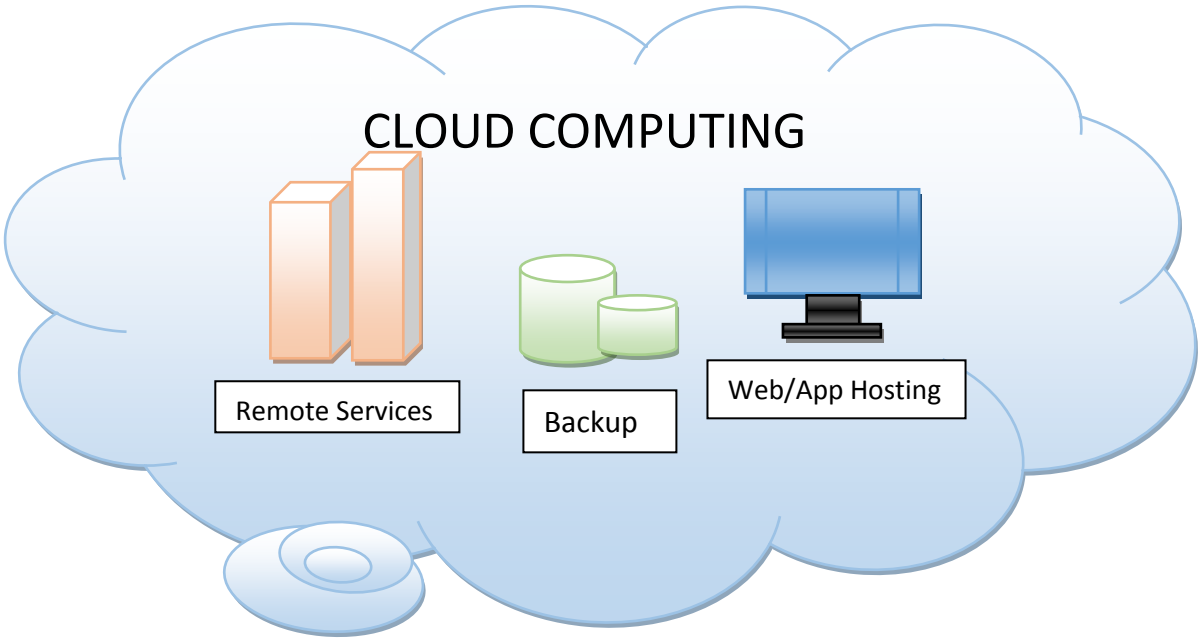


Fig.1.2 Services, backups, apps stored over cloud

1.1.1 Cloud services

There are three types of cloud services- IaaS, PaaS, SaaS. These services are described in detail below:

- **IaaS (Infrastructure as a service)-** This is a type of cloud computing that is responsible for resource computing virtualization on internet. On the behalf of its users the software, servers, hardware, storage and other infrastructure components are hosted by a third party. The tasks that include maintaining the system, handling backup and hosting the users application is done by this model. One characterstic of this model is that high scale resources are offered that is possible to modify as on demand. So this makes it suitable for any unexpected change that could be temporary or permanent for workloads. The customers of IaaS pay for either monthly, weekly or hourly basis for the use of the service. Sometimes customers also charged on the basis of the aggregate of the virtual machine space used. As this is a "pay-as-you-go" model, it helps capital cost elimination of using in-house

software and hardware. This environments comprises of the computerization of tasks those are administrative, have a dynamic scaling, policy-based services and desktop virtualization. If the providers of IaaS practice downtime then workload of users could be affected.

Suppose if a software product is being developed by a business, it could be cost-effective for the host and could examine applications by the providers of IaaS. This new software once is tested and developed, it is possible to remove it from the IaaS environment for better utilization or to save money or make resources available for other projects.

Example of IaaS providers are "Amazon Web Services (AWS), Windows Azure, Google Compute Engine, Rackspace Open Cloud, and IBM SmartCloud Enterprise". [17]

- **PaaS (Platform as a service)-** This is a cloud computing model that offers a platform and provides the developers with a environment that permits them to make applications and services on internet. Users can access this service using their web browsers. The users can construct their software applications with tools provided by PaaS suppliers. This service can have some features that are preconfigured that can be subscribed by the users as they can select those features that satisfy their requirement and abandon those that are not required by them. Therefore, building tha packages where expertise for hosting of client side is not mandatory, may vary from a "simple point and click platform" for providing the choices for infrastructure for progressive expansion. The services are updated regularly and the surviving features are modernized and a few extra features are also added. For this service, customers have to pay only for that subscription that they use. This serves aa s benefit for the clients economically as they have to share only the physical infrastructure with the users and this minimizes the cost. PaaS offers some of the features as – "operating system, server-side encryptinh environment, database management system, server software, support, storage, network ,access, design and development tools, hosting". PaaS is beneficial for business, web and software developers. By using PaaS, the application developers don't need to spend for physical infrastructure as virtual infrastructure can be rented leading to cost and practical profits. Also this service makes easy for the

non-experts to develop applications. Also this service is flexible as users have the mechanism to install only those features required in their platform. It provides adaptable features that can be modified according to the circumstances. Developers or teams at different locations can work together to create same application using internet and web browsers. Also the service is secured comprising recoveries and backups. So overall, it is perfect for new application development intended for web, mobile devices and PCs.[17]

- **SaaS (Software as a service)-** Consumers can access their software application on internet by using any cloud service under SaaS. Both individual and organization can use the applications hosted in cloud at a wide range. Users can access the services through internet. Enterprise consumers can use the applications for a variety of needs such as invoicing, tracking, sales tracking, monitoring performance, planning and communications- instant messaging and web-mails. SaaS can also be known as software on demand. It is similar to use it like to rent a software instead of purchasing it. Unlike any other software application that you have to purchaseit as a package and then get it installed on computer and then gettinh the software lisence for deploying it, the users of SaaS only need to subscribe the software generally on monthly basis instead of buying it. Purchased applications are accessed and used online with saved files on cloud instead of saving them on computers individually. SaaS have been valuable to organisations and individuals as the application only has to be run on cloud and there is no such additional cost of hardware as processing power is provided by the cloud to run applications. Once subscribed for the application, application is ready for use without any initial cost for setup. Usersonly have to pay for that limited amount of use of the application they have used and they can then terminate the subscription for that application when not required. Also updations for any software are usually available online often for free of cost for the existing customers. These updates automatically install to the customers software without any need to re-install te entire software again or any new software again. SaaS provides with a “cross device compatibility” that is these applications can be used through any internet enabled device such as phones, tabs for those who do not use the same computer all the time or for those who such kind of different devices. These applications can

be used from any place through “internet enabled devices”. An example of SaaS using business is the office software. [17]

Example of SaaS- facebook, google,twitter,flicker.

Avantages of cloud computing

Cloud computing offers various benefits to business organizationas and end users.

a) **Cost efficiency -** Organisations can save the software’s licence fee by using the software over cloud and can terminate the overhead charges as those of data storage cost, updating the software etc. Generally cloud is accessible at cheap costs than overall expenses of IT.

b) **Continuous ans convenient behavior -** The available services offered by the puclic cloud can be used by the end users anywhere he/she is located. Through this approach information can be accessed easily and also it has become beneficial as it is now easy accessing, viewing and modifying the files and documents. It gives a garaunteed service uptime that offers accessibility of resources continuously.

c) **Recovery and having Backup –** Data is stored on cloud that serves as the flexible solution for backup for securing information and recovery of data. Moreover, cloud itself is a storehouse of backup of data on local computers.

d) **Performance and scalability –** Cloud deployment is scalable. This is the intuitive feature of cloud. When required, instances of cloud are automatically deployable and resulting to pay for only those applications and data repositories needed by the user.

e) **Greater storing capability –** Offering a unlimited data storage, a large amount of data can be stored on cloud as compared to personal computers. One does not have to worry about cloud being out of space. It also minimizes the overall IT cost as it updates the businesss orgaisations to upgrade their computer hardware. [18]

f) **Small learning arch –** As people are used to cloud applications, this includes proving them a small learning curve, making easy for the users to accept them and making the speed become more faster.[18]

Disadvantages of cloud computing

a) **Privacy and Security –** If a company has saved its private dton cloud then its upto the cloud service provider to manage and preserve it. So the trustworthiness of the provider is very essential. Likely, privacy is also important as the vendors of cloud service has to maintain the trust of the companies and customers that their data will remain to be secured from an unauthorized access.

b) **Dependency –** This is the major disadvantage of cloud as the customers have to depend on the cloud providers. The organisations call this as "vendor lock-in".

c) **Downtime and Technical problems –** As other systems face dysfunctionality, it may also be possible even in the case of a very good cloud provider. Even the best cloud service may face downtime problem and outages. [18]

1.2 LIVE MIGRATION

Live migration is the transmission of virtual machine(s) from a physical host to another physical host or we can say from its original source to destination being in connection with the client or application in a cloud environment. Its aim is to transmit services between servers. The transmission is transparent to the users. When concerned with the virtual machines, these are operating systems or any other application environment installed on the software imitating like a hardware. When the process of live migration is done, VM performs without being noticed to the end user. Live migration is an essential feature in virtualization technology today. With this technology of virtualization, it partitions the physical machines into virtual machines that could be multiple in number and share a alike physical resource. It provides us with a maintenance that is proactive. If suspected with an coming up failure, the likely problem can be solved before interference of the service arrives. Live migration can also be implemented for load balancing where work is shared between computers consecutively to optimize the available CPU resources utilization. Virtual machines to be migrated to their destinations without/low performance degradation. This less migration cost has always been a concern. Several techniques have been applied for improving migration so that the end user gets a low response time and improved performance. The aim of live migration is to maintain flexibility i.e. moving of virtual machines from one host to another without any downtime or it can be said as without losing the service availability. Virtual machines are usually abstracted from the

hardware on which they run. With this flexibility we can match our virtual machines to our resources and replace hardware more easily. This makes IT and the business very fast and responsive all without impacting on the operations of the business. Miscrosoft server2008 adapted a feature of live migration by Hyper-V that allows migration without any disturbance of services. It is flexible, valuable and provides good agility. Data centers will have better migration performance if they do migration in multiple physical hosts of Hyper-V. It minimizes cost, rises productivity and helps data centers to minimize consumption of power. [2]

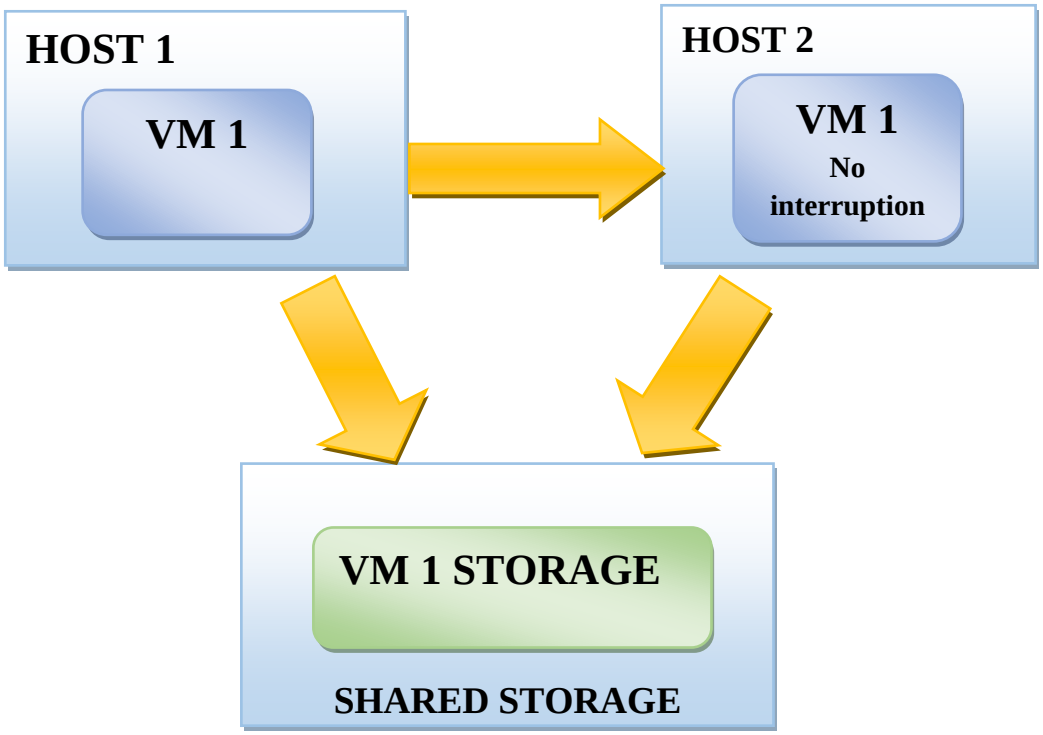


Fig.1.3 Live Migration of virtual machines and storage

1.3 VIRTUAL MACHINES

When concerned with virtual machine, 'virtual' means that the virtual machine should actually imitate like a real machine. These run in the virtual environment. It consists of its virtual CPU (software-based), network interface card (NIC) and a RAM hard disk. These could be either operating system or any application environment installed on the software imitating the dedicated hardware. Virtual machines does not require a specialized hypervisor-specific hardware. If the physical hardware hosts multiple running virtual machines, virtualization may require more processing capacity, bandwidth and storage

than a desktop or a traditional server. VMs can be moved easily, be copied and reassigned between host servers to optimize hardware resource utilization. When it comes to sharing the VMs, cost savings increase as more virtual machines share the same hardware platform, involving risk. It is feasible to put hundreds of virtual machines on the same hardware, but if there is failure in the hardware platform, it may take out dozens or hundreds of virtual machines. Because on a physical host, the VM might consume an unequal resource quantities (the available physical storage may be overtaken while another may store a little), IT professionals require to maintain VMs with available resources. [9]

1.3.1 TYPES OF MIGRATION

1.3.1.1 POST-COPY MIGRATION

In this technique, firstly VM is suspended at the source, its CPU state, registers and, optionally, non-pageable memory is transferred to the destination firstly and then within a second the execution starts. Then the VM as a hole is resumed at the destination. After reaching the target, the source then actively pushes the remaining pages of the VM. It might happen when the VM is not able to access those pages, thus a fault is generated. These faults are the so called network faults. These faulty pages cause the increase in the migration time and lowers the performance of migration. These faults are then redirected to the source where there faulty pages are responded. So post-copy then transmits each page exactly one at a time over the network. The metrics such as preparation, downtime, resume, total time helps to measure the live migration performance. [2]

1.3.1.2 PRE-COPY MIGRATION

In this technique, stop and copy phase is performed. Under this phase, the physical memory of the VM is first transferred from one host to another. If found, dirty pages are retransmitted to the destination and then the VM is resumed to the destination. These pages are dirty pages and are iterated repeatedly until either they reach their limit of iteration or the data becomes very small to effect any transfer overhead on network. The dirty pages are transmitted in the last iteration. So the time obtained between the pausing of VM on the original host and then resuming it on destination is called down-time. The downtime might range from a few milliseconds to seconds depending upon the memory

size and the running applications on VM. So many techniques are used to reduce the downtime so as to get a lower response time with effective performance. Pre-copy technique has been supported well for read intensive jobs. But there's a performance degration for number of dirty pages for the write intensive jobs. [2]

1.4 MAP REDUCE

There are many technologies using which the performance of virtual machines have been upgraded. One of them is using a map reduce that is been widely used and helps to improve the response time with migration of valuable information. Google has presented MapReduce that processes and generates large data sets on the clusters of computers in which users uses only two terms that is 'map' and 'reduce'. This program is composed of 'map( )' procedure that performs filtering and sorting of the data and 'reduce( )' that performs summary of the operations. By summary operation we mean for example counting the number of items in a queue. This technology is inspired by these two functions mentioned. The map reduce system manages different kinds of communications and data transfers those are running various tasks in parallel. It also provides fault tolerance and redundancy. This is a unique way of hiding a messy parallelization in a library. Also this hides the fault tolerance details, the way the distribution of data has been done and the load balancing. The libraries of mapreduce should be bale to tolerate the machine failures if occurs. Libraries of MapReduce have been written in many programming languages with optimization in different levels. Yahoo has sponsored Hadoop which is an open source of implementation of MapReduce. MapReduce is being widely used and experienced for large scale data applications in cloud. When we use MapReduce for migrating the virtual machines on different hosts, it helps in recovering the loss of whole node or the dirty pages if found. This can be used for large systems and also on migrating the multi-tier applications on host. The programmers without any experience with parallel and distributed systems can easily use the resources of a large distributed system. MapReduce is beneficial as it is simple and scalable, also has speed, built-in recovery, a minimal data motion and freedom so as to focus on business logic. These properties makes easy for the developers to write in various languages. It can process petabytes of data stored in a cluster and also does parallel processing, taking care of failures.

BASIC WORKING OF MAPREDUCE

The map function divides the input into ranges by the input format and creates a map task for each range that is in the input. It computes a set of key pairs or value pairs. These tasks are then distributed by the job tracker to the worker nodes. Each map task's ouptut is divided into a group and the group is of the key-value pairs for each and every reduce. Then in Reduce function, reduce collects the various results and combines them to answer the larger problem the master node tried to solve. Each of the reduce then pulls the relevant divided output into partition from the machines where the maps were executed and then writes its output back into the HDFS. Therefore, the reduce function can collect the data from all of the maps for the keys for which it is responsible and combine them to solve the problem.

When observed in detail the working of mapreduce, it consists of a master and slave. They perform in a collaboration to get the work completed. The master has a configuration file called “map” and the configuration ffile of slave is called slave. The “real master” node runs on a “Job Tracker deamon”. The slave performs its work and runs a deamon called “Teasktracker deamon”. The master assigns a part of the work by an algorthim that divides the work into partitions. This partition is known as split that is given to the subsequent tasktracker. The file tht are given s input are splited in amounts in a size of 64mb. The program is then copied on a group of machines. The master then selects a worker and allocates it one map task and aone reduce task. The worker with the task of map, reads the consistent input split contents. The key pairs of the nput split is analysed and delivered to every map operation that is user-defined. The key pairs that are intermediary formed by map operation are buffered in the memory. The buffered pairs are then periodically written to the local disks. These are partitioned by a partitioning function into regions. The master is responsible for the location of the buffered pairs in the local disk and then it passes those pairs to the reduce workers. As the reduce worker becomes aware of the locations of these buffered files, it reads the data on buffered files using a remote procedure call. As all the data is read by the reduce worker, it sorts the data using the intermediary keys so as to group the occurences of the same key. An external sort is used only if ti is a case of large intermediary data that is not fitting in the memory. The sorted intermediary data is iterated by the reduce worker. A key and a set of corresponding intermediary values is passed for every intermediary key that is unique to the users reduce

function. The reduce output is then considered the final output. So as all the tasks realted to map and reduce has been completed, the master awakens up the user program and the mapreduce call is returned to the users code. After the completion, the output is available in the output files.

The mapreduce library should be able to tolerate the faults. The master periodically pings every worker to check for faults. If the worker does not responds to the ping generated, then the master considers it a failed worker. When a mapt ask assigned to the worker is completed, it is resetted to the idle state that is initial. And so it becomes suitable for programming on other workers. And similarly, if the task is failed then it becomes suitable for rescheduling.

CHAPTER 2

LITERATURE REVIEW

With the increasing demand of cloud computing in business environment, a smooth live migration without any delay while communicating is what makes a user satisfied of the services to use. But with this, performance of virtual machines is also a great concern.

Sno.	Title	Author(s)	Year of Publication
1	MapReduce: simplified data processing on large clusters	Dean, Jeffrey and Sanjay Ghemawat	2003
2.	. Post-copy based live virtual machine migration using adaptive pre-paging and dynamic self-ballooning	Hines, Michael R, Kartik Gopalan	2009
3	A live storage migration mechanism over wan for relocatable virtual machine services on clouds	Hirofuchi, Takahiro	2009
4	Xen live migration with slowdown scheduling algorithm	Liu, Zhaobin	2010
5	User-level virtual networking mechanisms to support virtual machine migration over multiple clouds	Tsugawa, Maurício	2010
6	Kahuna: Problem diagnosis for mapreduce-based cloud computing environments	Tan, Jiaqi	2010
7	Shrinker: improving live migration of virtual clusters over WANs with distributed data deduplication and content-based addressing	Riteau, Pierre, Christine Morin, and Thierry Priol	2011

8	Efficient storage synchronization for live migration in cloud infrastructures	Haselhorst, Katharina	2011
9	Performance modeling of virtual machine live migration	Wu, Yangyang, and Ming Zhao	2011
10	Reducing Power Consumption and Improving Quality of Service in Cloud Computing Environments	Awano, Yuki, and Shin-ichi Kuribayashi	2012
11	Cloud Migration Research: A Systematic Review	Jamshidi, Pooyan, Aakash Ahmad, and Claus Pahl	2013
12	Dynamic resource allocation using virtual machines for cloud computing ooollenvironment	Xiao, Zhen, Weijia Song, and Qi Chen	2013
13	Data as a Service (DaaS) for Sharing and Processing of Large Data Collections in the Cloud	Terzo, Olivier	2013
14	VMbuddies: coordinating live migration of multi-tier applications in cloud environments	Liu, Haikun, and Bingsheng He	2013

Hines, Michael R, et al (2009), deals with developing a technique of post copying live virtual machine migration. Post copy migration accepts the moving of the memory content of virtual machine until the CPU state of virtual machine has been transferred to the target and continued there. It transmits all the processor state to the target and continues virtual machine at the target. Then it drives the memory pages from source to the target. The purpose of this technique is to keep small downtime by minimizing the amount of virtual machine state that needs to be transmitted during downtime. Adaptive pre-paging is also supplemented that proactively arranges the pre-fetched pages by pre-fetching them from the disk and then try to hide high-locality page faults or cache misses latencies. A dynamic self ballooning mechanism is employed to evade transmitting of free pages. Ballooning

technique is used for resizing the memory allocated to the virtual machine. This allows the reduction of the footprints of memory which is done by the guest operating system that releases the memory pages to hypervisor back. DSB is implemented that directly responds for allocating memory requests of OS without any kernel patch requirement. This approach has been performed in Xen environment. The evaluation done demonstrated those situations that significantly improved the performance of migration done by post-copy by transmitting of pages and the overall time of migration. This study also proved post-copy to be a practical technique for migration of virtual machines. Also it evaluated metrics in contradiction of pre-copy. The metrics for live migration of virtual machines here used in this approach are "preparation time, downtime, resume time, page transfer, total migration time and application degradation". The approach applies memory pages fetching by combining four techniques that are "demand-paging, active push, pre-paging and dynamic self ballooning (DSB)". In "demand paging" technique, every page is transferred once over the network. By "active push" technique, the dependencies that are residual are to be removed from the source as rapidly as possible. The "pre-paging" technique reduces the various network faults by using clues of virtual machines pattern of accessing pages. The DSB minimizes the transfer of free pages while being migrated and improves both post-copy and pre-copy performance. But here, this implementation did not supported methods to target node crash failures. [2].

Hirofuchi.T. et. al(2009), Presented an advanced storage access mechanism which supports live migration of virtual machines over WAN. It repositions having minimum impact of I/O performance of virtual machine disk among source and destination sites. This mechanism is independent of implementating VMM(virtual machine monitor) that compresses application environment into virtual machines. Also this system worked good enough for KVM and Xen without modifying them. Also it allowed load balancing of VM among datacenters that increased energy efficiency. An I/O consistency of virtual disks before and after migration was proposed for solving the consistency of storage access. The study focused on the problem of consistent access to storage in WAN environment. So a mechanism for advanced has been proposed for virtual machine live niigration and migration of disks over WAN. This will relocate the virtual disks on other site by using a WAN bandwidth efficiently that was available. The mechanism worked as a target server storage. The mechanism has been collection of "a target server and a proxy server of a block-level I/O protocol". Also a NBD protocol connected the target server and the proxy

server to which both the hosts- source and destination were connected. The NBD protocol uses TCP/IP. Also the mechanism runs with migration of memory by a virtual machine migration. At the source, all i/o were performed. The disk bocks were updated by the target server and at the destination, the virtual machine is restarted. Disk migration was started by the proxy server. An "on-demand fetching" mechanism was done as requested by virtual machine. So a complete relocation of virtual machines was done between source and distant site in away that was completely transparent. This mechanism was proposed as it was not possible to transparently relocate virtual machines and was not cost effective. This implementation was suggested to support a storage access mechanism to support live migration of virtual machines over WAN. [3].

Liu, Z,.et al(2010), Xen allows live migration of virtual machines between physical host systems without being disrupted. The disruption during a live relocation is generally 100 to 150ms that do not affect the migration. For live migration in Xen, SSA (slow scheduling algorithm) was implemented in which the migration domain assigned to CPU resources was decreased by reducing the dirtying page rate according to CPU activity reduction. The aim of this algorithm was to minimize the resources of CPU of migration domain. Total migration time and downtime for virtual machine live migration was minimized. This was shortened by SSA under high dirty rate environment. It worked as when the SSA was called, it minimized a virtual CPU for migration domain. By this the equivalent activity of the CPU was minimized. Until this, the dirty page output came to a condition of stop ans copy in iterations. The short scheduling algorithm consisted of a "slow down flag and a slowed down flag" to every domain. While performing migration in iterations, currect round of the dirty page increased than previous iteration round. Overall, the SS module relies on the change of the CPU scheduling algorithm in Linux kernel. Thi algorithm did not affected the other domain services and also did not affected the real time migration. Hence the performance of this approach eevaluated in less transfer time and downtime. By restricting the total migration time, this reduced the risk of migration failure if there were fault in the network. The downtime has to be reduced as the systems availability will be high then the priority of real-time migration can be revealed. [3].

Tsugawa, Maurício(2010), While migrating virtual machines across different subnets requires network support so that the virtual machine's network state remains unchanged. If the IP of virtual machine changes, it results in loss of data and performance. For this, user-

level virtual network architecture is introduced. The focus was on the aspects of process of networking and encouraged to apply network virtualization mechanism. Its mechanism allows migrating the virtual machines over multiple clouds without the support of private networks and maximising the network performance of the migrated virtual machines. Here ViNe software is used in which communication is established between two subnets and two virtual machines are created, each having a subnet. It ia a approach of virtual networks that offered a connenctivity that is end-t-end between nodes. This connectivity remains even in private network or secured by firewalls. To show the performance with ViNe infrastructure, virtual machines create communication among them with one pair of virtual machine is made to communicate directly and other pair of virtual machine to communicate using ViNe infrastructure. It maintains multiple virtual networks that are mutually isolated. Also it is based upon "user-level network routing software". This establishes a overlay network by internet infrastructure. The machine that runs a ViNe software is a ViNe router. It works as a access for machines to the overlay network associated to a similar LAN segment. ViNe can be changed by alteration of the virtual routers operating constraints. Also overlay routing of ViNe is based on maintaining the routing tables by virtual routers typically arranged in two ways- "Local Network Description Tables (LNDTs) and Global Network Description Tables(GNDTs)". The LNDT refers to a nodes ViNe membership and the GNDT provisions ViNe deployment structure. ViNe infrastructure enables the communication without interruption, migration of virtual machines over multiple clouds. ViNe extension allows virtual machines to move freely of destination subnets. The environment in which the ARP techniques can be implemented and protection of network can be raised, ViNe is possible to deploy. In every domain one virtual router performs as a access to the overlay network. An optimization done by the ViNe is describing a large network that is virtual that is shared by all the virtual machines. Virtual routes react to the ARP requests if the IP address that are absent. Also ViNe were to be installed to connect the virtual machines deployment on the private and public subnets. [4].

Jiaqi Tan(2010), presents Kahuna, a technique to observe the performance of the MapReduce systems for peer systems. It observes the performance of the running nodes in the MapReduce systems and finds the culprit node. Hadoop has been used to perform the MapReduce operations. Kahuna's focus is if a peer similarity based approach can confine the performance problems precisely in both small and large clusters. Here two algorithms

that are based on peer-similarity has been used. These two algorithms analyse the problems in the Hadoop clusters by comparing OS-level performance metrics, black-box and whitebox metrics imitated from Hadoop's logs respectively. Hadoop enables distributed, data intensive, parallel applications by breaking their massive jobs/programs into smaller tasks that are applying the map and reduce functions. A data-set is decomposed into smaller parts and each task parallelly processes a different partition. The diagnosis algorithm identifies the jobs performance problems that causes the job to take long time to complete, if the problem were not present. While performing experiments, the effectiveness of Kahuna has been evaluated on a variety of workloads which has the traces of Hadoop. This is under four different workloads and these are the- two simple benchmarks packed with Hadoop (Sort, RandWriter), and two Hadoop applications (Nutch, Pig) that are generally used in installations in the real world. While performing experiments, faults were also injected to test the performance. The experiments are then conducted to trace-data using both Kahuna-WB and Kahuna-BB, which returned a list of nodes of culprits. Also Kahuna-BB's and Kahuna-WB's has the ability to detect and limit the injected performance problems for each Hadoop workload. So basically the hypothesis arises that the nodes exhibit peer-similarity in fault free conditions resulting a peer-dissimilarity that gives rise to peer-comparison approach, applied to Hadoop. Applying this peer-comparison approach to multiple levels of behaviour can enhance the diagnosis coverage. [5]

Live migration becomes expensive when large amount of data is transferred specially when migrating many virtual machines rather than a single virtual machine. Shrinker was designed for a live migration system to advance live virtual clusters migration between data centres that were interconnected by WANs. Classification of improvement of live migration and optimization is as-

a) Optimization of pre-copy approach

b) Alternatives to pre-copy

To allow migration of virtual machines over WAN, there are two issues that needs to be resolved-

a) Shared storage lacking

b) Relocating to a different IP networks

Riteau,.et al (2011), Shrinker improved live migration of VM over WAN by declining total data transferred and total migration time. Shrinker used cryptographic hash functions. While migration of virtual machines, duplication of data occurs. Shrinker avoids this. Its working is to keep a track of the memory page and disk blocks that are being delivered to the destination. Before sending these, the source computes hash value of this disk and queries service with it. If no memory page or disk block having the same hash value arrived before then it transforms solutions for the support of migration of virtual machines over multiple providers [6].

Haselhorst, et al (2011), Live migration overcomes some added challenges when VMs used local persistent storage, completely needs the disk state to be transferred to the destination host while the virtual machines are in running state and hence changing the disk state. Approaches for persistent storage during VM live migration in cloud infrastructure is implemented and evaluated. The approach is that XGE provides infrastructure controlling a cluster of virtual machines offering live migration of virtual migration during runtime between physical machines. XGE gives a facility of live migration to migrate virtual machines between physical machines during the runtime, enhancing the current migration much and allowing a cheaper and faster virtual machine migration to ease load balancing [7].

Wu, Yangyang(2011), Further regression method is used to performance model based on estimating the migration time by allocating the resources and then guiding the resource management decisions for a virtualized data centre or clouds. Sequence of experiments were conducted on Xen-based virtual environment. The virtual machine migration time measures the running CPU, memory, disk I/O or network I/O intensive benchmarks by assigning different amount of CPU assigned to Xen's Domo which practices the migration. The aim of the study was to evaluate an accurate time of migration of live migration of the virtual machines, based on allocation of resources and guiding the decisions of resource managment for a virtualised cloud system or data center. A relationship was also built between allocation of resources and time of migration by running the virtual machines on different types of benchmarks that are highly resource intensive. The experiment was conducted in Xen environment that supported virtual machines by a strong resource isolation and a garaunteed performance. So in Xen, Dom0

can access the physical devices directly and also the non-privileged VMs. Dom0 controls the limit of CPU usage limiting the amount of CPU available for the virtual machine. Dom0 coordinates the memory transfer if virtual machines on both the host- source and destination. So Dom0 relies on how fast and early the live migration can be done. Performance of virtual machine migration is measured by its downtime and migration time. This model predicts migration time and guides resource management decisions. CPU usage of virtual machine migration and modelling the migration performance over different CPU allocations on source and destination host is done [8].

Awano, et al(2012), Besides this cloud computing services are used widely by various ICT devices in IT industries. This wide use of these cloud computing services ICT devices consumes lot of power and may damage the quality of services. So to reduce this excessive power consumption of ICT devices and the communication time, WAN accelerators are introduced. That is using ALR (Adaptive Link Rate) technology, it will reduce the transfer rate of communication link when the traffic is small on these links. Power sensors are attached to each electrical devic so as to keep a check on the demand of energy and to observe the pattern of power consumption. A possibility is also discussed for detecting quality of sign service of ICT devices from the power consumption pattern. Example in case of viewing a video, packets are rejected, the number of video packets being processed is reduced temporarily that results in minimum consumption of power. The method applied here to minimse the power consumption by introducing WAN accelerators, they shorten the communication time in a file transfer application. More power is consumed when link transfer rate is higher. The minimizing of power consumption is done by increasing packet rate and shortening communication time. But this is possible only for transmission of huge data. Also for reduction of power consumtion in the network, communication link traffic is small for minimum packet transmission rate. So its been assumed that more the rate of transmission, higher will be power consumed. The communication time could b shortened by increasing the rate of packet transmission. This would also increase the time of sleep mode of communication link when a relaxed transfer is used. A method for sign of quality of service deterioration detection has been proposed with a pattern of power consumption. Also a method for prevention of performance degradation for live migration of virtual machines has been proposed [9].

Jamshidi, et al (2012), Cloud computing has been seen as a opportunistic business strategies in the field of competition. Some research has been concerned with the migrating effort of moving leagacy on-premise software to target cloud environments. These work focuses on the existing method, technique, processes and frameworks enables migration directly or contributes indirectly justifying the decision of migrating to cloud. On the growing demand of migration towards cloud, an investigation on cloud migration has been considered. Similarities and differences have been measured between service-oriented architecture (SOA) and cloud migration. A systematic literature review (SLR) has been on previous few studies reducing biasness and following sequential methodological steps for researching on literature. Some steps are followed, these are as- firstly, identifying the need for SLR. A second step is specifying the research questions. And thirdly, defining and evaluating review of protocol. Further some cloud references model has been discussed that aims to identify the existing work and areas left uncovered in cloud migration [10].

Xiao, et al (June 2013), While migrating the virtual machines, the physical machines should have the capacity as needed by all the virtual machines running on it. If the capacity of the physical machine is below satisfaction, physical machine is overloaded. And if the use of physical machine is minimised till they satisfy the needs of all virtual machines, turning off the idle physical machines can save energy. So for achieving a good balance between overload avoidance and green computing, automated resource management has been designed and implemented. For overload avoidance, physical machines utilization was kept low so as to reduce overload possibility if resources need more virtual machines. For green computing, maximum utilization of physical machines should be kept high to make efficient use of their energy. Resource allocation system was developed to avoid overloading in system, minimising number of servers used. Also the concept of "skewness" is introduced to measure uneven server utilization. A load prediction algorithm designed can capture the future resource usages of applications without looking inside the virtual machine. Also servers were defined as hot spot and cold spot based on which that server is selected whose skewness can be reduced the most by accepting virtual machines to be migrated. The hot spot server is when any of the resource utilization is above hot threshold, indicating the server has been overloaded and so a few of virtual machines running need to be migrated away. Whereas a cold spot server is when all resource utilizations is below cold threshold, indicating the idleness of the server

saving energy. This is done when the average utilization of resources of every server is less than the green computing threshold in the system. Green computing algorithms invoked when active servers average utilization is less than the deployment of all resources on active servers. Memory size of the cold sopt is defined to aggregate virtual machines memory size on it. So the virtual machine live migration cost has been determined by its memory paths [11].

Samira Daneshyar , et al, provides a comprehensive systematic review and analysis of large-scale dataset processing and dataset handling challenges and requirements in a cloud computing environment by using the MapReduce framework and its open-source implementation Hadoop. Requirements for MapReduce systems are defined to perform large-scale data processing. The MapReduce framework and one implementation of this framework on Amazon Web Services is proposed. An experimentation of running MapReduce system in a cloud environment. It also can help developers to do parallel and distributed computation in a cloud environment. A Major web company, Amazon web services platform offers a service called Amazon ElasticMapReduce to store and process massive datasets by running MapReduce system on Amazon cloud." It utilizes a hosted Hadoop framework running on the web-scale infrastructure of Amazon Elastic Compute Cloud (Amazon EC2) and Amazon Simple Storage Service (Amazon S3). EC2 is a web service platform that provides resizable compute capacity in a cloud. Amazon S3 provides a simple web services interface that can be used to store and retrieve any amount of data, at any time, from anywhere on the web." When experimented, the program determined the number of occurrences of each word in the given dataset. We executed the program based on our proposed framework in a cloud computing environment hosted by Amazon Web Services. The study described Hadoop, an open source implementation of MapReduce to process large-scale datasets. Also the fundamental and specific requirements to develop a framework were determined. A framework to process a large dataset in a cloud environment in parallel and distributed fashion, as well proposed Amazon Web Services as one instance of the using MapReduce framework was established [12].

Live migration has been done with single VMs. But when done in multiple data centres or clustered data centres, performance issues arise. Haikun Liu, et al(2013) presents VMbuddies that focuses on reducing the performance degradation and migration cost of multi-tier applications. For implementing VMbuddies, an adaptive network bandwidth

algorithm has been proposed that minimizes the migration cost in terms of migration completion time, network traffic and migration downtime. Also a synchronisation protocol has been proposed for synchronising all the virtual machines. In earlier correlated migration problems, pre-copying algorithm was widely used. Liu's study also focuses on the pre-copy algorithm in Xen, extending to other VM migration techniques. In pre-copying, a stop-and-copy phase was performed that transmits the dirty pages while source VM stops execution temporarily. After all transmissions when the final transmission is done, theVM on host B resumes and takes over the VM on host A. The synchronization protocol introduced managed to save the migration time. This manages all the VMs to proceed by performing a stop-and-copy phase at the same time. Here, stop-and-copy phase is postponed until all the virtual machines reach a pseudo-synchropoint and then proceed wait_stop-and-copy phase. When all VMs reach at the pseudo-synchropoint, an arbitrator sends them message to reach synchropoint and proceed their migration to destination. The synchronization protocol allows different resource allocations and VM scheduling mechanisms. An advanced bandwidth allocation method then is used that schedules the VM migrations individualy for the best migration performance. It manipiulates the migration that affects the bandwidth during the wait-and-copy phase. Each virtul machine is allocated the required amount of bandwidth. It describes the According to it, the VM with the largest memory dirtying rate should be migrated last.[13] VMbuddies perform VM migration in multiple tiers simultaneously and smartly decides the bandwidth among VMs. Its primary goal is to determine how much network bandwidth should be allocated to each migration process to minimize total migration cost of multi-tier applications. But during wait_stop-and-copy phase, time is consumed for waiting all the VMs to arrive.

CHAPTER 3

PRESENT WORK

3.1 PROBLEM FORMULATION

Performance of live migration of virtual machines across geographically distributed data centres has a great impact on cloud enviroment. Its been required to move the interactive applications in their respective data centres with low response time. So earlier VMbuddies have worked with the synchronisation protocol and an adaptive network bandwidth algorithm so as to make the migration performance of multi-tier appliations effective. The sychnronisation protocol used pre-copy technique to synchronise the virtual machines while being migrated parallely that would reduce the migration time as shown in the figure below:

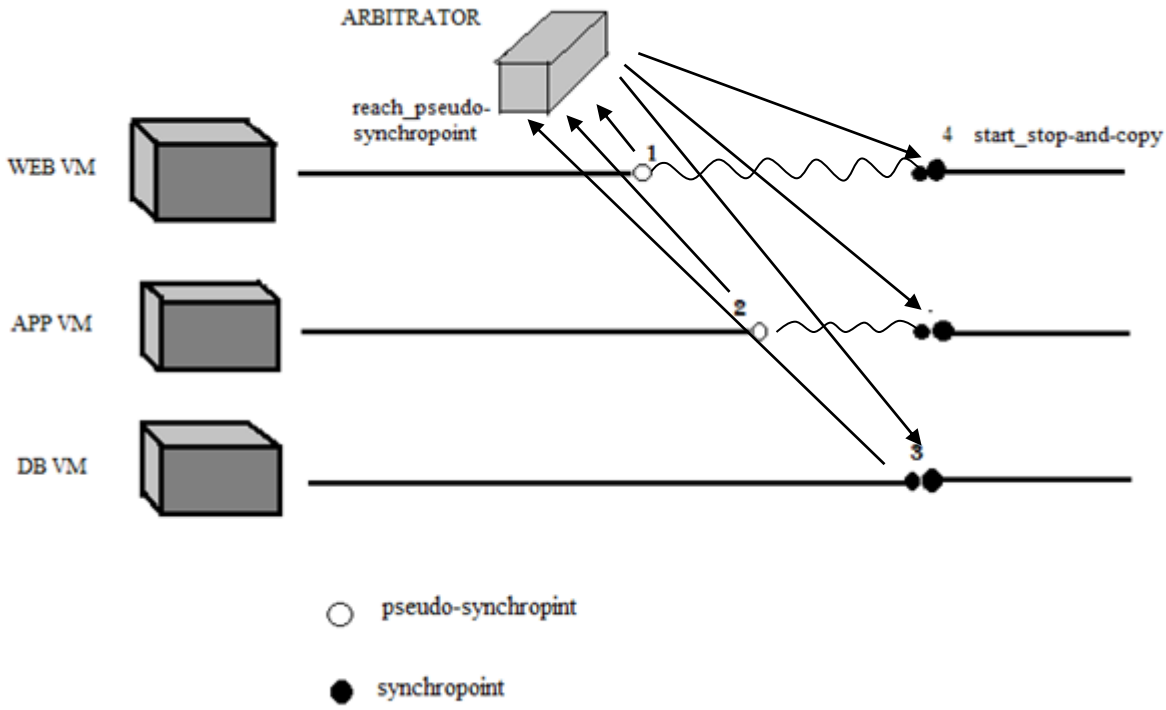


Fig: 3.1 Synchronization of live migration of multi-tier applications

As in the figure, the multi-tier applications (web VM, application VM, database VM) are migrating to their destinations, the first virtual machine reaches the pseudo-synchropoint and sends the message to the arbitrator “reach_pseudo-sychncropoint” and goes in the wait-and-copy phase until the other VMs reach the pseudo-syncrhropoint. When the last virtual machine reaches the pseudo-synchropoint, the waiting state of previous vitual machines finishes and they receive a “start_stop-and-copy” message from arbitrator. The arbitrator keeps a record of the number of virtual machines arriving at the pseudo-syncropoint. After this if there is any dirty page, that is retransmitted iteratively during the waiting phase and the virtual machine then only proceeds to destination when the dirty pages retransmitted. The virtual machines then proceed for start-and-copy phase. A network bandwidth algotrithm is then applies to allocate the required amount of bandwith for best performance. But in this case of the synchronization protocol, the waiting phase time is not utilized properly as the time is being consumed during retransmitting the dirty pages iteratively and making the virtual machine to wait to reach at its destination within minimum time.

By introducing mapreduce technique, all virtual machines will run parallel saving the downtime. Also this helps the VMs to become more optimized and valuable information is migrated to the destination, eliminating the dirty pages from the memory while VM is in synchronising state. Mapreduce uses the waiting phase of the migration and removes the discrepancies while migration, resulting in reduction of the performance degradation of the correlated VMs in the cloud environment.

3.2 OBJECTIVES

- To study and analyse the existing live migration techniques in cloud computing.
- To develop a framework of synchronization protocol for live migration of multi-tier applications in cloud computing.
- To implement the framework in homogeneous and heterogeneous cloud environment.
- To compare the new framework with existing synchronisation protocol.

3.3 RESEARCH METHODOLOGY

Here we describe the methodology used in this study. Our focus is on improving the performance cost of virtual machines migration by reducing the migration time and cost, by introducing the mapreduce function into VMbuddies for coordination of live migration of multi-tier applications. In this work, VMbuddies is upgraded by introducing a mapreduce function to it. During live migration, VMbuddies introduced a synchronization protocol with pre-copy technique. We introduced a mapreduce function in synchronisation protocol. In the synchronization protocol, as each of the virtual machines reach at the pseudo-synchropoint, they send the "reach_pseudo-synchropoint" message to the arbitrator and proceed for the "wait-and-copy" phase. The arbitrator then records the number of VMs arriving by a variable p. They remain to be in "wait-and-copy" phase until the last VM reaches to the pseudo-synchropoint and the earlier VMs receive the "start _stop-and-copy" message from the arbitrator. Till they are at the "wait-and-copy" phase, we introduce mapreduce function and allow VM to transmit its dirted pages at this stage. The map() function will sort and filter the VM and foward it to reduce() function that will summarize it and reach at synchropoint. The VMs that performs maximum wait-and-copy phase till they wait for other VMs to reach at wait-and-copy, will have maximum optimization as map() function will be performing on them and the VM is becoming more updated or filtered. This filtered VM will then get reduced using reduce() function when all the VMs reach till mapreduce and then will be moved on to the synchropoint. Once all the VMs reach at synchropoint, the arbitrator sends the "start _stop-and-copy" message to all the VMs. So this will help to save the cost for retransmitting the dirty pages repeatedly to the destination. The updated VM will be reached at the destination in less time and the migration cost is reduced compared to previous VMbuddies migration. A fault tolerance approach is later applied to control the migration from failures. Later, the migration proceeds with the network bandwidth allocation algorithm for best migration performance.

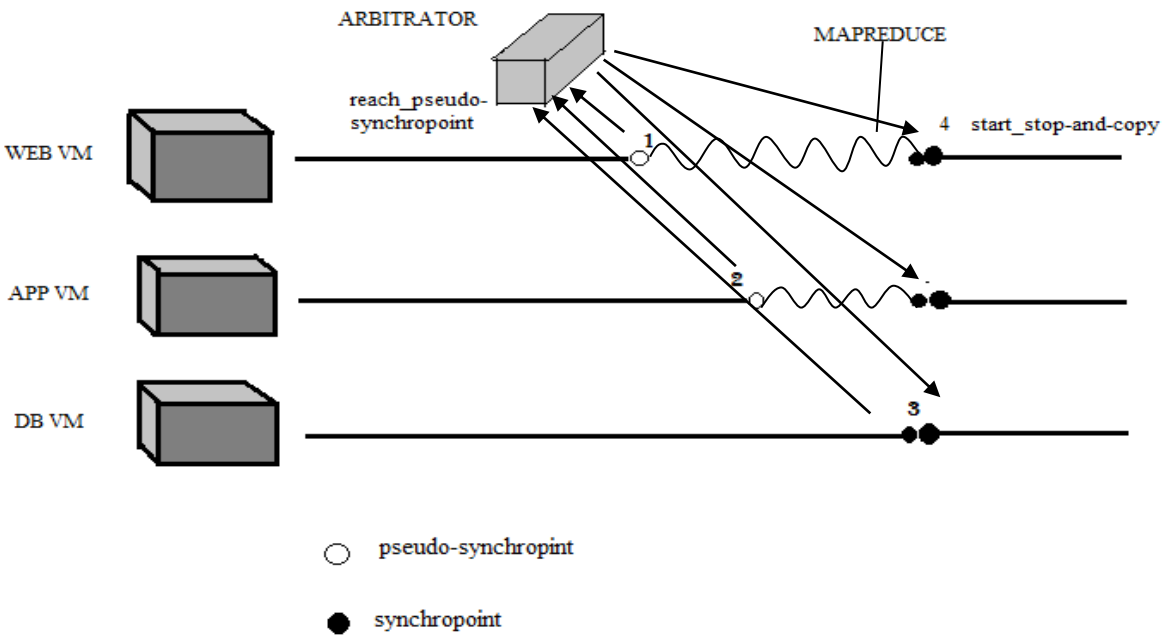
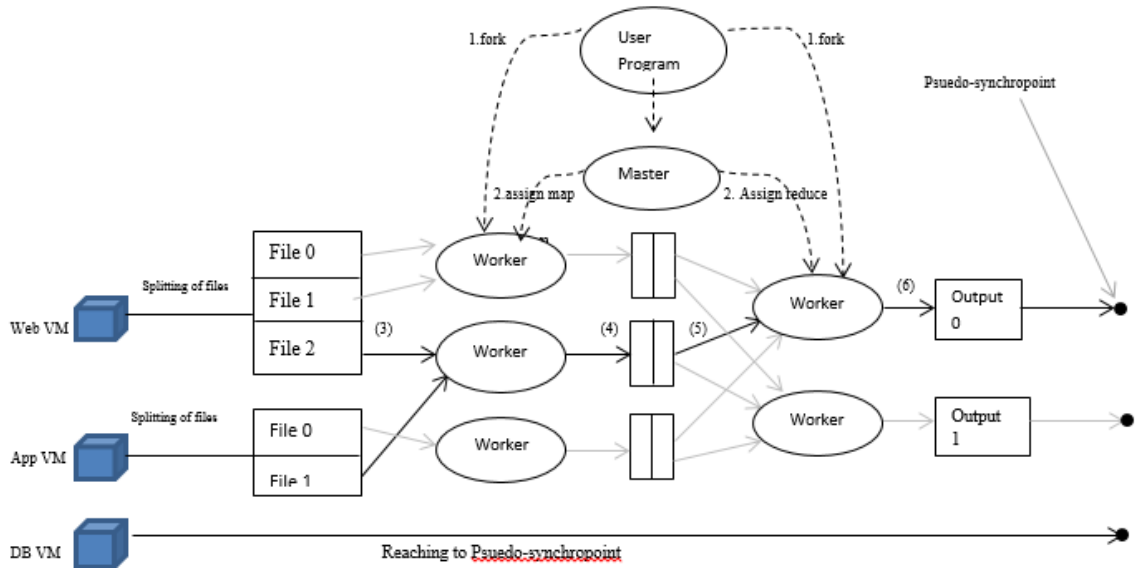


Fig.3.1 The architecture of synchronization of live migration of multi-tier applications using mapreduce function.



(3).Read (4) Local Write (5) Remote read (6) Write

Fig.3.2 Working of the Synchronization of live migration of multi-tier applications using mapreduce function, by utilizing the wait-and-copy phase for mapreduce

Fig 3.1 shows how the mapreduce will be placed in the synchronization protocol. It shows the mapreduce operation will start as as soon as virtual machines reach to the pseudo-synchropoint.

Algorithm for synchronization protocol using MapReduce:-

1. Let m is the total VMs to be migrated
2. Let p ← 0 /*the number of VMs that reach the pseudo-synchropoint*/
3. **Begin migration**(VM[i])
4. **while** VM[i] does not reach the pseudo-synchropoint **do**
5. pre-copy the memory of VM[i];
6. send message "reach_pseudo-synchropoint" to arbitrator;
7. proceed "wait-and-copy" phase;
8. do map()
   sort and filter **then**
   reduce()
9. if receive message "start_stop-and-copy" **then**
10. proceed "stop-and-copy" phase
11. **endif**
12. **end migration**
13. **Begin Arbitrator()**
14. if receive message "reach_pseudo-synchropoint" form VM[i] **then**
15. p ← p+1;
16. **while** p!==m **do**
17. mapreduce
18. if p= = m **then** **/***all VMs reach the synchropoint*/
19. for i=1 to m **do**
20. send message "start_stop-and-copy" to VM[i];
21. **endfor**
22. **endif**
23. **endif**
24. end **arbitrator**

CHAPTER 4

RESULT AND DISCUSSIONS

Our experiment has been performed using cloudsim. Cloud analyst is a simulation tool that is user for simulating “large scale applications”. This tool seperates the simulation experiment from the experimentation of programming allowing modeller to focus more on the simulation parameters. Also this makes the modeller to execute repeated simulations allowing the parameters to modify easily and quickly. A graphical representation of the simulated outcomes makes the result more analysed and efficient. This tool is easy to set up and peform simulation experiment as only a graphical user interface is to be provided. A modelling nature of simulation sometimes depends on many parameters that need to be assumed. So for different quick and repeated results, the parameters need to be changed simultaneously. From these repeated different results, a graphical results in the form of charts or tables can clearly summarize all the values. This representation is important for indentifying the output parameters pattern and is helpful in comparing them. The cloud analyst helps to determine the response time between the data centers and also to analyse the migration cost of virtual machines. This also compares the results of different inputs. Our experiment in cloud analyst is done in java that show the comparable results between the previous vmbuddies and our extended vmbuddies.

4.1 Implementation on Cloud Analyst

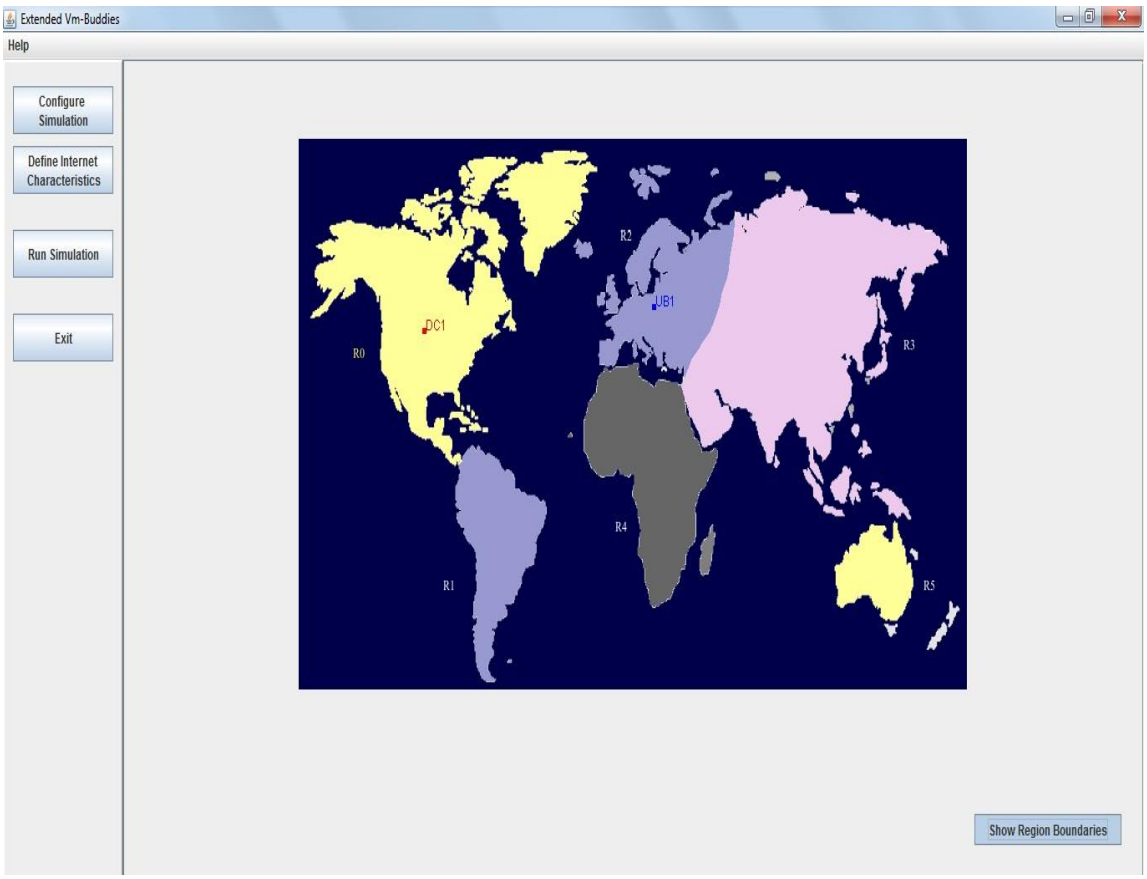


Fig 4.1 Cloud Analyst Simulation

This the main screen of cloud analyst. As in the figure, the map of the world is shown in the simulation panel. In this the cloud anlyasy has divided the world into 6 regions. All elements of the simulation locations are identified with regions. The option of "show region boundaries" shows the 6 divided regions labelled. On the left side of the simulation panel is the control panes having a few options. The options of the control panel are as:

- Configure simulation- This shows the screen of configure simulation.
- Define Internet Characterstics- This shows the screen of internet characterstics.
- Run Simulation- This shows the execution of the simulation.
- Exit- This closes the cloud analyst.

4.2 Configure Simuation

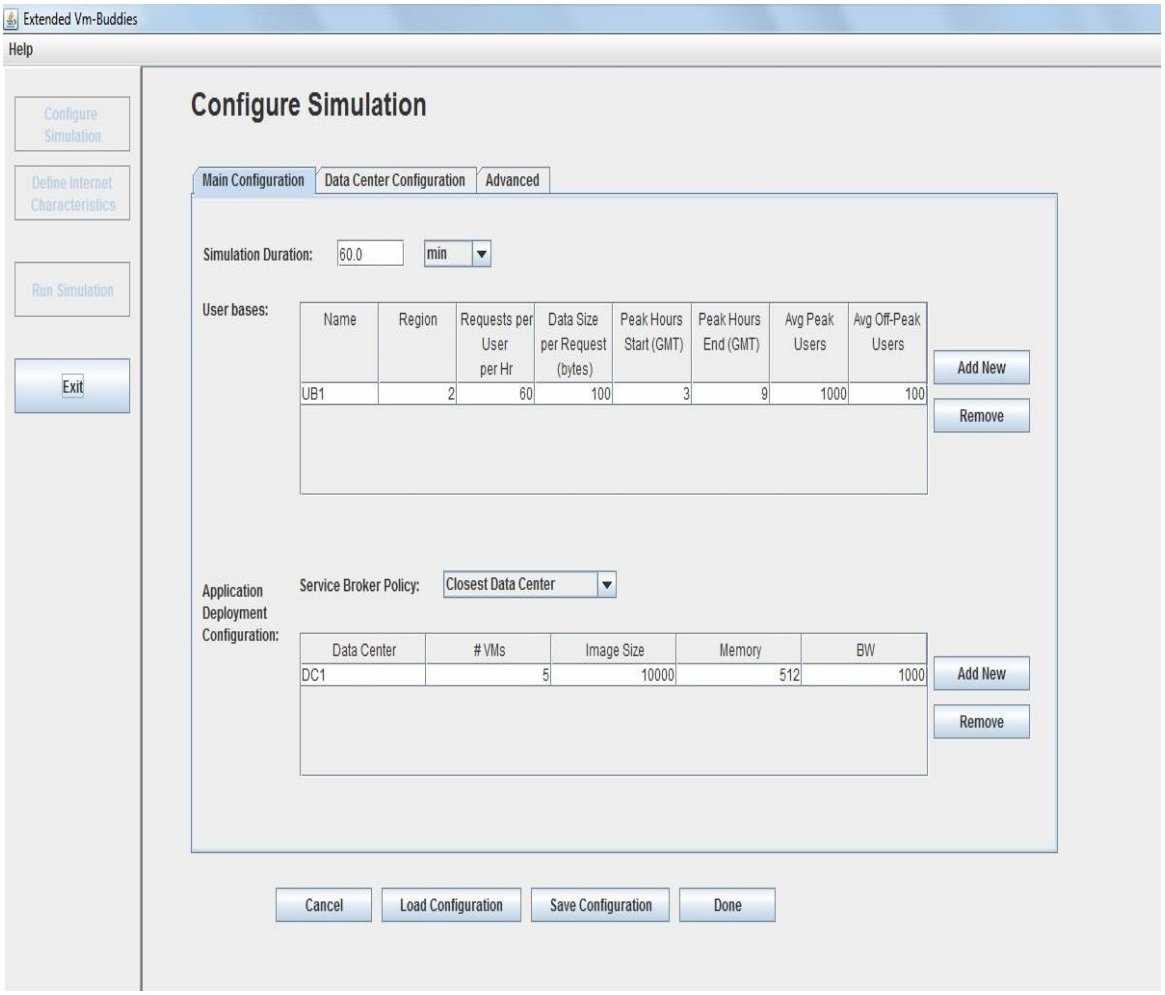


Fig.4.2 Configuring simulation

Under configure simulation, we have 3 tabs. These three tabs are- main tab, data center configuration and advanced.

4.2.1 Main Configuration Tab- Under this tab we have three options of simulation duration, user bases and application deployment configuration.

i) Simulation Duration- By this option, we can set the duration of simulation to be calculated in. It could be in minutes, hours or days.

ii) User Bases- This shows a tables that consists of the list of user bases in the simulation. For each user base, there is a configuration field shown in a row. The fields are:

Name – Selects the user base name.

Region – Selects the region.

Request per hour – This shows the number of user requests per hour.

Data size per request (bytes) – This shows the size of data per requests in bytes.

Peak hours start (GMT) – This shows the starting of peak hour.

Peak hours End (GMT) – This shows the when the peak hour has been stopped.

Average Peak Users – This shows average users of peak hour.

Average off-Peak Users – This shows the average users reduced.

Number of user bases can be added or removed by using the "add new" and "remove" button.

iii) Application Deployment Configuration- This describes the number of virtual machines in a tabular form assigned for the applications in respective data center, along with virtual machine details. The fields contain :

Data centre – This shows the list of data centres in a dropdown list made in the data centre tab.

Number of VMs – This describes the number of virtual machines to be assigned to a application from the data centers selected.

Image size – This tells the size of single virtual machine in bytes.

Memory – This shows the memory amount accessible to single virtual machine.

BW - This shows the bandwidth amount accessible to single virtual machine.

iv) Service Broker Policy – This option permits to choose the brokage policy among data centers that selects which data center would accept traffic from which user base. The three policies are- closest data center, optimized response time, reconfigure dynamically with linux.

The buttons “load configuration” and “save configuration” are available. The “save configuration” button permits to save the current simulation configuration generated as a file with a .sim extention. And the “load configuration” loads the earlier saved simulation configuration.

4.2.2 Data Center Configuration

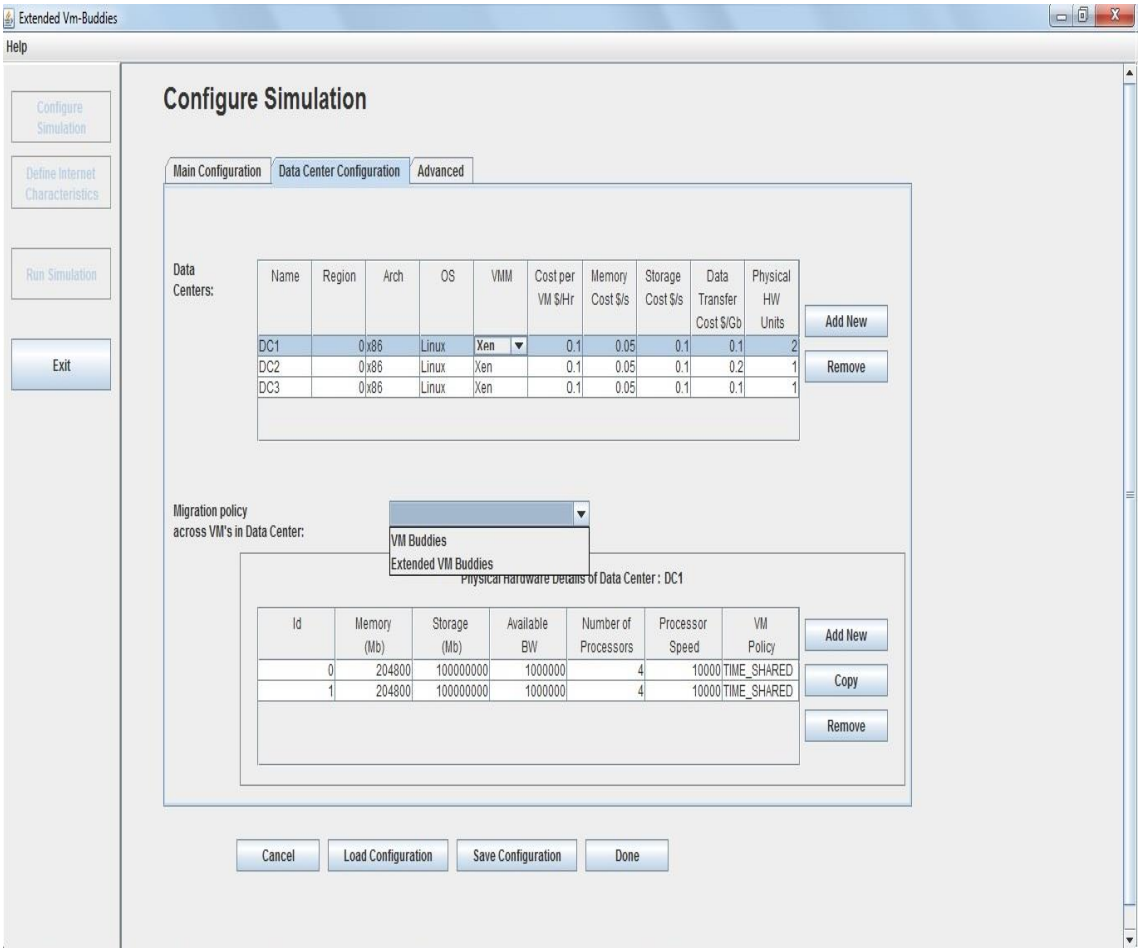


Fig.4.2.2 Configuring the data centers

This has two parameters- Data centers and Migration policy among VM’s in data centers. This defines the data centers configuration listing the data centers. In tha “data centers” option, the fields are as:

Name – Allows to select the data centers.

Region - Allows to select the regions.

Arch – This is the architecture of the servers for data center and it is x86.

OS – This shows the dropdown lost to select the operating system. Eg. Linux.

VMM – This is the virtual machine monitor. Here we have performed in Xen.

Cost per VM $/Hr – This shows the the cost of each virtual machine per hour.

Memory cost $/s – This shows the cost of memory per second.

Storage cost $/s - This shows the cost of storage per second.

Data transfer cost $/gb - This shows the cost of data transfer per gb both in and out.

Physical Hw Units

In the migration policy, two policies are defined- VMbuddies and Extended VMBuddies.

The parameter “Physical hardware details of the data center”. The data center selected in above field of “Name” in data centers, will appear in the “Physical hardware details of the data center”. Its parameters are such as:

Machine ID – Descirbes the name of machine.

Memory – This is measured in mb.

Storage - This is measured in mb.

Available BW – Defines the available bandwidth

Number of Processors – Defines the processors

Processor speed- This is measured in MIPS.

VM Policy – Policy can be time-shared.

With the option of “add new”, “copy”, “remove”, new inputs can be added, copied and rremoved.

4.3 Data Center Configuration

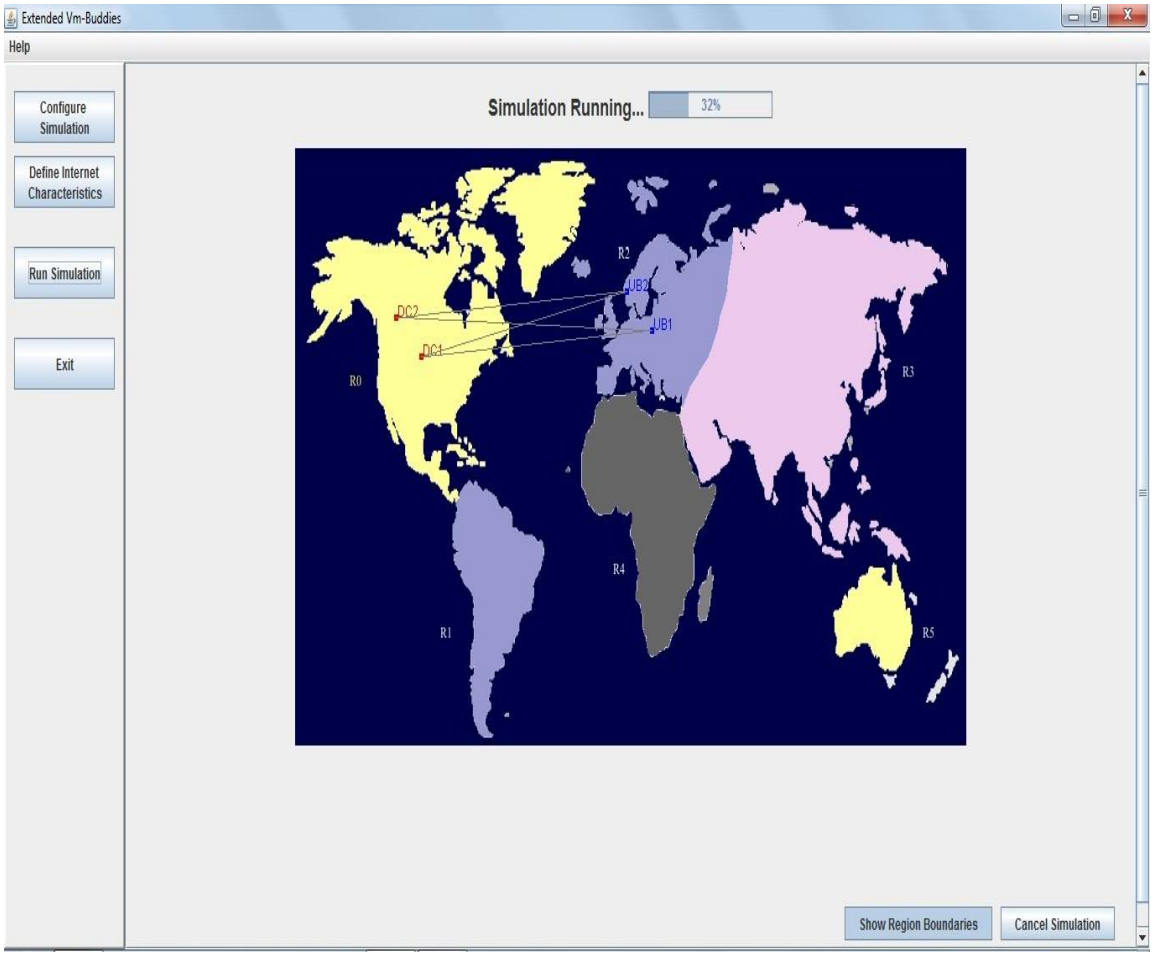


Fig.4.3 Configuring the data centers

For running the simulation, all the above screens has to be filled and then click on "run simulation" in the main screen to configure the results. This will begin with the simulation and a progress bar at the top will show the percentage of accomplishment of simulation. It shows the number of data centers and user bases selected in the region map as given as input while in configuring simulation. As the completion of the percentage is done, the average, maximum and minimum response time is displayed on the main screen. Along with it, it shows the simulation results. The result displays the overall response time for user bases and data center processing time in miliseconds. Also the response time of the regions is displayed that has been selected earlier for simulation. A response graph displays the response generated by the user bases hourly. The cost of

vitual machine and data transfer is also displayed, showing the total cost of including data transfer cost and the virtual machines cost.

So the simulation results discusses 3 results-

1. Overall Response time- This is the overall response time generated for answering to a request service.
2. Data center processing /time- This is the time generated for processing of data centers.
3. Total Cost details- This calculates the cost of virtual machines and the data transfer cost.

RESULTS

We have compared a configuration of previous vmbuddies without mapreduce with the extended vmbuddies with mapreduce and the results clearly differentiates the minimized cost of the extended vmbuddies as compared to the pervious vmbuddies. The simuation we have performed within local data centers in Xen environment. We saved a same confirguration result for vmbuddies and extended vmbuddies. We have selected three data centers at three different regions and three user bases for the 3 regions. The results generated are the- overall response time, data center processing time and the total cost of migration. The values for the parameters taken are shown below:

Table 4.5 Configuration of minimum user bases

User Bases Name	Regions	Peak Hrs(GMT)	Average Users Peak	Average Users Off-peak
UB1	1	3:00 - 9:00	10000	1000
UB2	2	3:00 - 9:00	15000	1500

This table 4.5 shows the minimum workload of user base that is the averge number of users represented for an efficient simulation.

Table 4.5 Configuration of average user bases

User Bases Name	Regions	Peak Hrs(GMT)	Average Users Peak	Average Users Off-peak
UB1	1	3:00 – 9:00	55000	5500
UB2	2	3:00 – 9:00	82500	8250

The table 4.5 shows the average workload of user bases that are representing the average number of users for an efficient simulation.

Table 4.6 Configuration for maximum user bases

User Bases Name	Regions	Peak Hrs(GMT)	Average Users Peak	Average Users Off-peak
UB1	1	3:00 – 9:00	100000	10000
UB2	2	3:00 – 9:00	150000	15000

The table 4.6 shows the maximum workload taken to evaluate the efficiency of simulation by representing the maximum number of users. We have also assumed a configuration od data centers by giving the following inputs as:

Table 4.7 Configuring the data centers

Data Center Name	Region	Cost per VM (Rs/Hr)	Data Transfer cost (Rs/GB)
DC1	0	6	3
DC2	0	6	3

This table shows the activities of the data management managed by the data centers and routes the received requests of the users from the user base through internet to VMs. In our experiment,we have taken two data centers ar region 0 in data center configuration. Other few parameters used in our experiment are as followed in the table 4.8.

Table 4.8 Parameter table

Parameters Used	**Values**
User Grouping factor in use base	10
Request Grouping factor	10
Executable unstruction length per request	100
Load Balancing Policy	Round Robin
VM Image Size	10000
VM bandwidth	1000
Data Center Architecture	x86
Data Center OS	Linux
Data Center VMM	Xen

On the bases of above inputs, following results have produced. In each result, two data centers have been selected. For each output, both vmbuddies and extended vmbuddies have been executed for different configurations. Figure 4.4, 4.5, 4,5 shows the total cost, overall response time and data center processing time for both migration policies. The result compares the policies and shows that the migration cost of extended vmbuddies is quite less than the previous vmbuddies and the reduction in cost does not affects the rresponse time and processing time.

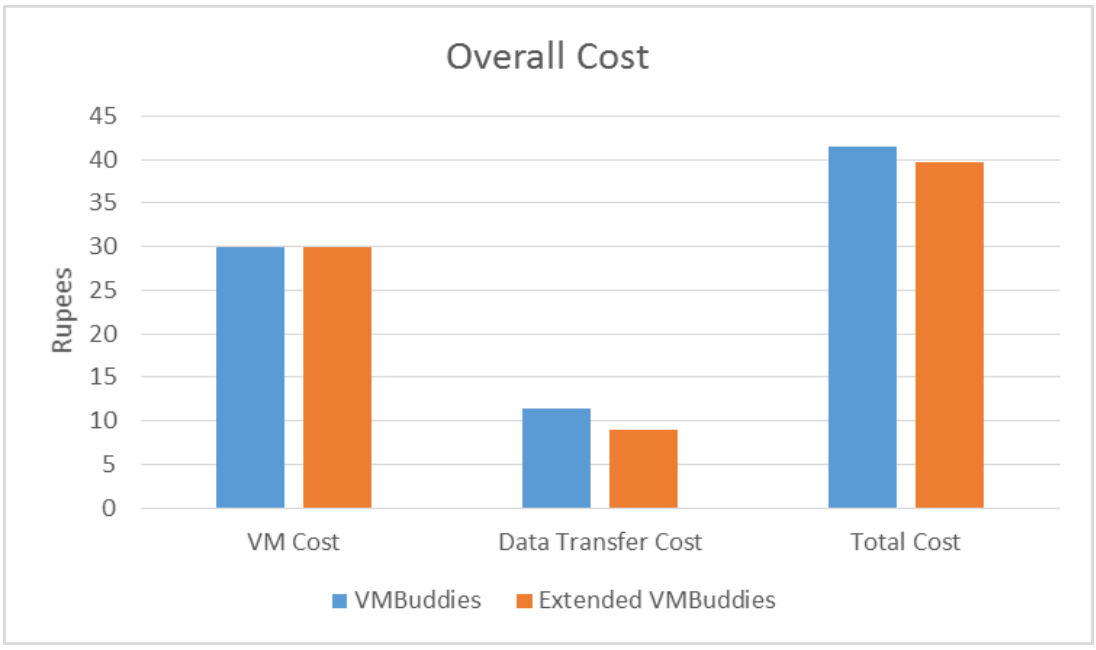


Fig.4.4 Graph for Overall migration cost

The graph above is calculated by recording the data for response time between the user bases and data centers. We found that the overall response time between the vmbuddies and extended vmbuddies remain same. The response time is not affected.

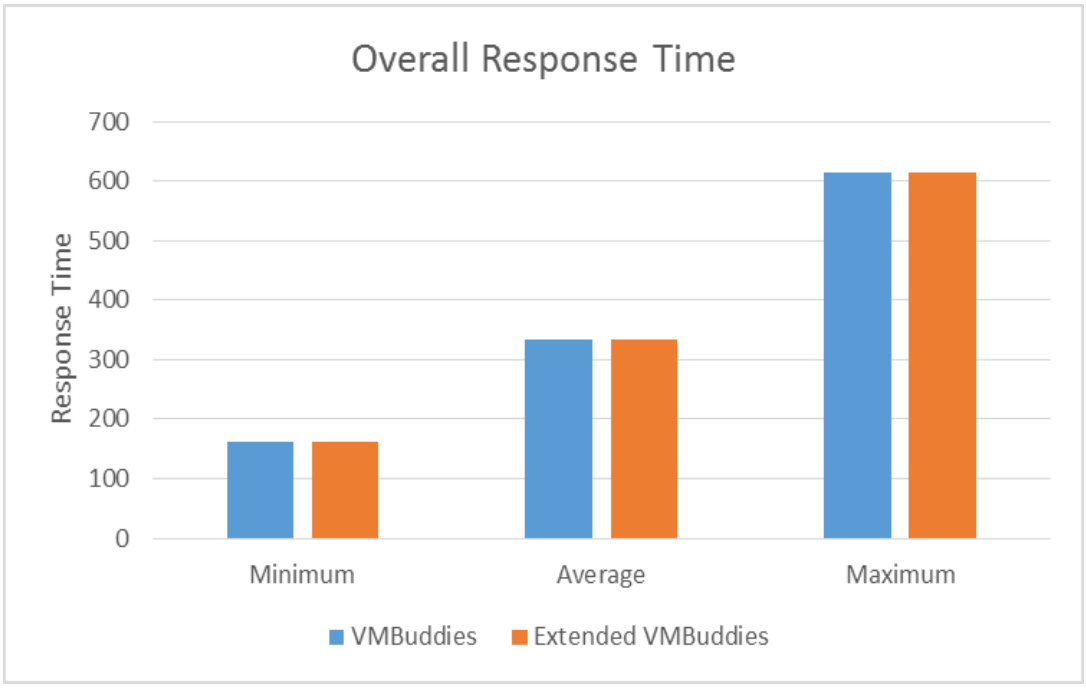


Fig.4.5 Graph for Overall response time

In the fig.4.5, the processing time of data centers for vmbuddies and extended vmbuddies remain to be same.

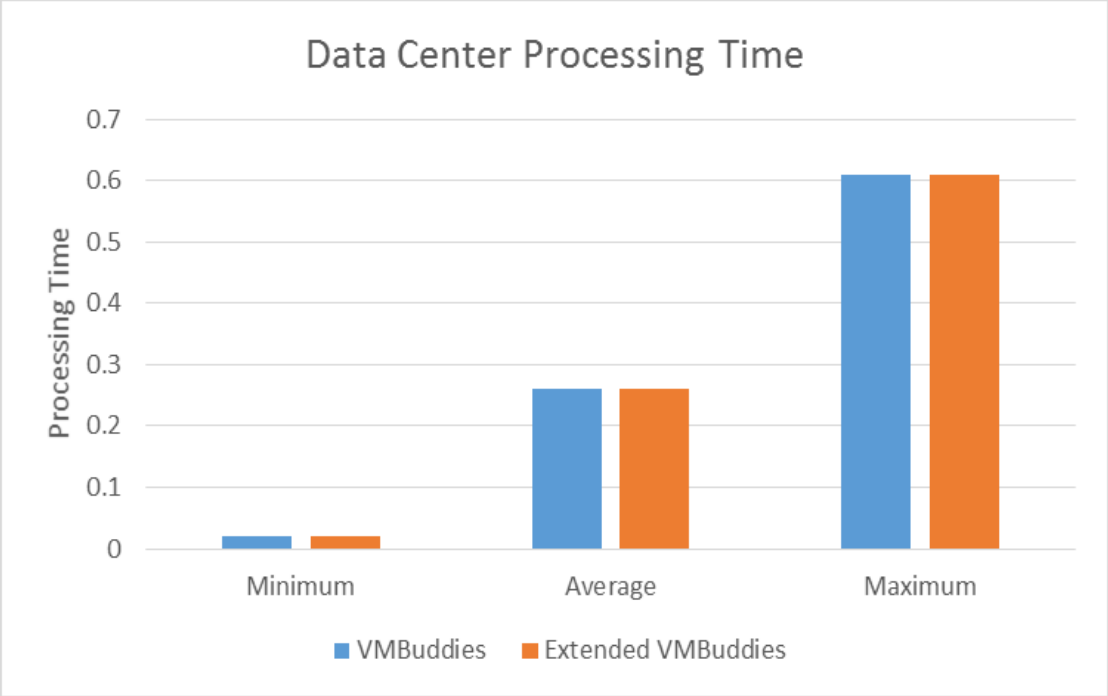


Fig.4.6 Graph for the Data center processing time

In the fig.4.6, the cost of migration of virtual machine varies for vmbuddies and extended vmbuddies. The virtual machines cost, data transfer cost and the grand total cost of vmbuddies is more than the extended vmbuddies. So comparatively, extended vmbuddies overall migration cost is minimized as mapreduce is introduced in the synchronization protocol.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

As the working of VMbuddies for correlated VMs in migration in local data centres is to minimize the migration cost and time, also reducing the performance degradation. To further enhance VMbuddies, mapreduce function is formulated that saves the cost of retransmitting the dirty pages while all the VMs are synchronising. With this, as the number of dirty pages are minimized and retransmittion of them is eliminated, this saves the transfer cost of retransmission and further saves the migration cost too. So as more and more virtual machines get correlated and migrated between local data centres, faster they reach and better will be their performance while migration to their destinations. In our future scope, we will implement the mapreduce vitual machine migration between geographical data centers.

CHAPTER 6

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