

## Extensive survey on Virtual Machine Migration techniques in Cloud Environment

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**Abstract:** In today's competitive environment, cloud computing gain more popularity due to its capability to provide the various services at the minimum cost. To achieve the minimum computation cost, virtualization of cloud datacenter has been performed for better resource utilization and further Migration of Virtual Machines helps to balance the workload, energy efficiency and fault tolerance. Migration techniques make capable to system for server consolidation and ease of Management. After the extensive survey of various migration techniques, it has come out that various migration techniques has been proposed for the high availability of cloud data centers but there is scope for betterment still due.

**Keywords:** VM Migration, Cloud Computing, Load Balancing, Pre-Copy Migration, Post –Copy Migration.

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### I. Introduction

Cloud computing is a developing technology that provides different kind of services [1] such as infrastructure, software and different applications through network. Cloud can also be defined as a distributed computing paradigm, which is a group of interconnected and virtualized computers that are provisioned and presented dynamically [1] as unified computing resources, offered as a pay-per-use service. The target of cloud computing is better use of distributed resources, put them together in order to achieve higher throughput and be able to perform large scale computational problems. For this purpose, there is need to sequence the activities and perform the migration of virtual machines from one physical unit to another to balance the load. This section of introduction concern about the little bit detail about cloud computing, Virtualization and Virtual machine migration.

- 1.1 Cloud Computing:** This is the outstanding technology of current era, which is basically a resource pool of distinguish computers. This pool of resource is designed to provide the service to the user on pay per basis. Nowadays, users are not willing to pay large amount to buy complete version of Hardware or application they required. Users are willing to pay only for that period for which they are getting the service [2]. In other words, Cloud Computing is a system of introducing a connection of exclusive servers entertained on the Internet in spite of a local server or personal Computer [3].
- 1.2 Virtualization:** The concept of virtualization act as key element in Cloud computing environment. It gives the real peak to the cloud environment with its prominent features. It was firstly implemented in 1960 on the IBM mainframe computer. It is abstraction of available resources, which are required to fulfill the request by user. It split the physical machine into number of virtual machines to provide the service to number of users. "A virtual machine (VM) is a software implementation of a computing environment in which an operating system or program can be installed and run" [4]. In virtualization, a single physical machine is capable to run multiple operating systems to provide the service to user with different requirement. It carries a host program known as Hypervisor which gives the capability to multiple operating system share a single host. It is responsible to provide the required resources to the each operating system and ensure that they don't interrupt each other.
- 1.3 Virtual Machine Migration:** VM migration plays an important role in today's competitive edge. It is very crucial element in cloud computing for efficient utilization of resource and cope up with the need of users. In the VM migration, VM of one physical machine is migrated to another physical unit to achieve the prime objective like power management, resource sharing, fault tolerance, mobile computing, load balancing and system maintenance. VM migration can be broadly classified as live or non-live migration. In the present age, live migration is recommended at the large extent to achieve the efficient resource management. To measure the performance of live migration, there are various performance metrics such as preparation time, down time, resumes time and application degradation etc.

The rest of paper is concerned with the review of migration techniques, section 2 presents detailed classification of migration techniques, Section 3 deals with the comparative study of migration techniques, section 4 comprises the research issues and open challenges for the further research and section 5 is the concluding section which gives the actual findings of this research paper.

## **II. Classification Of Migration Techniques**

VM migration is the prime element in the cloud environment due to its objective such as minimization of downtime, optimization of migration duration and optimal use of bandwidth without degradation of the services. VM migration techniques can be broadly classified as live(warm) and non-live (Cold) VM migration. A live migration technique doesn't suspend the application service and transfer the data and control from one host to another with least disruption of services. On the other hand, non-live VM migration, firstly pause the running job, copy the content and then it resume the services again. It leads to larger down time which is the major drawback in the system. In the Live migration two main steps are performed, 1) Switching of control from source machine to destination, 2) Transformation of data from source to destination. Live migration techniques can be further classified as Pre-copy, Post and Hybrid.

**2.1 Pre-copy memory migration:** In this migration technique, firstly memory is transferred then execution is transferred. In this migration techniques, it firstly lead to warm-up phase then it lead to stop and copy phase.

**2.2 Post-copy memory migration:** In this technique, firstly copy the memory then transferred the control to the destination. It works completely opposite to the Pre-copy migration technique. It has four variations for migration of memory pages from the source such as demand paging, active pushing, dynamic self ballooning and pre paging. In the demand paging, it will send the page only when the page fault occur means when it is demanded at the destination machine. Due to this feature, it leads to the slowdown the process, so it is unacceptable because of total migration time and degradation of application. Active pushing reduce the residual dependency through actively push the VM pages from source to the target machine. Dynamic self ballooning manages the number of free pages during the migration. On the other hand, Pre-paging reduce the major network faults and also reduce the duration of resume phase by anticipating the major page fault and transfer them to the destination machine.

**2.3 Hybrid memory migration:** Hybrid memory migration technique is combined the features of two techniques pre-copy and post-copy. In this migration technique, firstly it implement the pre-copy means it copy the required pages to the target machine then it lead to the post copy steps by resuming the virtual VM then it lead to demand paging means it lead to provide the page to target machine when page fault occur only. Hybrid memory migration leads with five steps such as preparation, bounded pre-copy rounds, VM State Transfer, Resume VM and On Demand paging.

Non-Live Migration techniques firstly stop the process then it will migrate the VM memory state from source server to target server. It will not continue the services until whole data is not migrated. Process Migration [5] has been introduced as foundation in the era of Non-live migration technique. Many of the researcher has proposed various techniques which are discussed in the next section but the live migration technique has achieve the main attention of researcher for research due to its capability to serve the system without disturbing the running system, which is demand of today's environment for sustainability.

## **III. Comparative Study Of Migration Techniques**

In the above section of this paper, complete classification of migration techniques has been discussed. This section is mainly deals with the comparative study of prominent work published in this field mainly in consideration of live and non-live migration techniques. Most of the work has been published in present age is related to live migration techniques but this paper also gives comparison of non-live migration techniques.

**3.1 Non-Live Migration Techniques:** Before the age of cloud computing, distribution system use the non-live migration technologies because in these techniques, system has to halt for time required for migration. The basic advantage of non-live migration technique is that migration time can be predicted and it also grantee that all the memory VM pages will be transfer to destination machine exactly once, which lead to no page fault in the system. The main work has been done in the field of non-live migration has been done in the decade of 2000 when the internet take its real shape. One of the no-live VM migration techniques Internet Suspend Resume lead with the process of halt and transfer but it has lowest speed due to its dependency on the Internet connectivity as compared to the Process domain. Process migration is more complex then the Internet Suspend resume technique and both of the techniques lead to the QoS degradation due to its disconnection during the VM migration.

**3.2 Live Migration Techniques:** Lot of work has been done for live migration technique by the prominent researcher. This section is concerned with the comparative study of some of the prominent work in this field bases on the some parameters such as platform used, Migration Pattern, downtime, Event for migration and performance metric used for evaluation as presented in the table I.

Method	Platform Used	Migration Pattern	Down time	Event for Migration	Performance Metrics
Improved MM Algorithm[6]	CloudSim	Pre-copy	L	Resourceutilization>threshold	Load balancing, System Maintenance
OEMACS[7]	C++	Pre-Copy	L	Resource utilization< threshold	Resource utilization, Power consumption
Optimized MBFD[8]	CloudSim	Post-Copy	M	Maximum utilization < upper threshold	Energy consumption, Minimum no. of migrations
Sandpiper[9]	Linux 5.0	Pre-Copy	L	Resource usage> threshold	Number of hotspot relieved
Server storage[10]	Matlab	Pre-Copy		Network bandwidth usage>threshold	Throughput Transfer packet loss
Improved ACO-VMM[11]	Matlab	Pre-Copy	L	Overall SLAViolation<threshold	SLA violations and Number of migrations

#### IV. Research Issues And Open Challenges

As above said, lot of work has been done in the field of migration for efficient resource utilization but there is scope for the research in the various areas like Seamless connectivity, Application performance, security concern, network link issues and Big VM Data Size etc. All of these issues have greater scope for improvement to achieve the better results in the VM migration techniques. In the present scenario, resources are limited so optimum use of resources is an important element.

#### V. Conclusion

This article depicts an extensive study on virtual machine migration techniques. Migration techniques are broadly classified as live and non-live migration techniques. Comparative study of non-live and live techniques present that non-live techniques was the area of research in past decades, now live migration techniques are burning issue for the research. After the comparison of various migration techniques this has been come out there is scope in various fields such as energy management, load balancing and fault tolerance management techniques.

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