



# **B.M.S College of Engineering**

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## **DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING**



**Course – Cloud Computing  
Course Code –19IS5PCCLC  
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## **Title of the Topic LIVE VM MIGRATION**

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## **Abstract**

- Cloud computing is proving itself an emerging technology in IT world which provides a novel business model for organizations to utilize software, applications and hardware resources without any upfront investment.
- The cloud computing services and infrastructure are mostly owned by a third party called cloud service providers.
- As compared to existing IT models, cloud computing offers many advantages like scalability, flexibility, efficiency and non-core activities.
- With the broad development in mobile applications and advancements in cloud computing, a new expansion is being expected in the form of mobile cloud computing (MCC).

## **CHAPTER 1**

### **1.INTRODUCTION**

- ❖ Cloud computing is proving itself an emerging technology in the IT world which provides a novel business model for organizations to utilize softwares, applications and hardware resources without any upfront investment.
- ❖ Cloud' is used as a metaphor for Internet and its main objective is customization and user defined experience. In other words cloud computing provides shared resources, software and information through Internet as a PAYGO (Pay-as-you-go) basis.
- ❖ The cloud computing services and infrastructure are mostly owned by a third party called cloud service providers.
- ❖ Cloud computing offers an innovative model for the organizations to use software applications, storage and processing capabilities of cloud without investing on the infrastructure.
- ❖ As compared to existing IT models, the cloud computing offers many advantages like scalability, flexibility, efficiency and non-core activities

### **1.2 Problem Definition:**

- ❖ Thoroughly analyse VM migration and its various implementations, and provide an objective overview with benefits and drawbacks.
- ❖ This presentation provides an overview of VM migration benefits and techniques and discusses its related research challenges in data center environments

### **1.3 Objective:**

- ❖ The objective of this project is to analyse comprehensively the process called VM migration, and highlight its benefits, drawbacks and various implementations.
- ❖ Using the knowledge from our research papers, we aim to provide the most optimal solution with respect to migration to the Virtual Machines.

## CHAPTER-2

# LITERATURE SURVEY

**Live migration** refers to the process of moving a running virtual machine or application between different physical machines without disconnecting the client or application. Memory, storage, and network connectivity of the virtual machine are transferred from the original guest machine to the destination.

It includes:

- Load Balancing
- Server Consolidation
- Operation Flexibility
- Reduced Overhead
- Disaster Management
- Increased Fault Tolerance

Live migration is an extremely powerful tool for cluster and cloud administrator. to improve manageability, OS instances may be rearranged across machines to relieve the load on overloaded hosts. In order to perform the live migration of a VM, its runtime state must be transferred from the source to the destination with VM still running.

There are Two major approaches: Post-Copy and Pre-Copy memory migration-

**Post-copy** consists of four key components: demand paging, active pushing, prepaging, and dynamic self-ballooning. It shows that post-copy significantly reduces the total migration time and the number of pages transferred compared to pre-copy.

In **Pre-Copy**, Many technologies are combined, existing pre-copy approaches are improved, multiple VMs are migrated, and specific application loads are considered. The technologies are: Combined Technologies, Improved Pre-copy Approaches, Multiple VMs migration, Specific Cloud Environments, Application / Workload Specific Technologies and Other Technologies

❖ **Post-copy approach** is transfer of memory content after the transfer of process state. We employ a combination of four techniques to fetch memory pages from the source: demand paging, active push, pre-paging, and dynamic self-ballooning (DSB). Post-copy VM migration is initiated by suspending the VM at the source, by suspending the VM a minimal subset of the execution state of the VM (CPU registers and non-pageable memory) is transferred to the target. The VM is then resumed at the target, even though most of the memory state of the VM still resides at the source. At the target, when the VM tries to access pages that have not yet been transferred, it generates page faults. These two faults are trapped at the target and redirected towards the source over the network. Such faults are referred to as network faults. The source host responds to the network-fault by sending the faulted page. Since each page fault of the running VM is redirected towards the source, this technique can degrade performance of applications running inside the VM. However, pure demand-paging accompanied with techniques such as pre-paging can reduce this impact by a great extent.

❖ **Pre-copy approach** In the first round it transfers all the memory pages to destination machine then iteratively copies pages modified in last round.. Pre-copy approach has many categories like:- Combination of many technologies, improvement in existing approaches of pre-copy, migration of multiple VMs, and consideration is given to specific application loads., the Hypervisor typically copies all the memory pages from source to destination while the VM is still running on the source. If some memory pages change (become 'dirty') during this process, they will continue re-copied until the rate of re-copied pages is not less than page dirtying rate. Pre copy has 2 phases-Warm-Up and Stop-and-Copy Phase.

**Warm-Up Phase** : In warm up VM memory migration phase, the hypervisor copies all the memory pages from source to destination while the VM is still running on the source. If some memory pages change during memory copy process dirty pages, they will be re-copied until the rate of re-copied pages is not less than page dirtying rate.

**Stop-and-Copy Phase:** After the warm-up phase, the VM will be stopped on the original host and the remaining dirty pages will be copied to the destination, and then the VM will be resumed on the destination host. The time gap between stopping the VM on the original host and resuming it on destination is called "down-time", and ranges from a few milliseconds to seconds according to the size of memory and applications running on the VM. There are some techniques to reduce the migration down-time, such as by using probability density function of memory change

## **Review on Various VM Migration Techniques**

**Energy Efficient Migration Techniques** :Huge amounts of data need heavy resource requirements. If this data is not properly managed then it would affect the utilization of the server and their cooling. This consumes a lot of power about 70% of maximum power consumption even at their low utilization level.

**ii) Load Balancing Migration Techniques** :Load balancing is a migration technique that distributes the load among different physical server to help in minimizing resource consumption, enhance scalability and avoiding over-provisioning of resources.

**iii) Fault Tolerant Migration Techniques:** This technique migrates the VM from one physical machine to another even if any part of system fails.

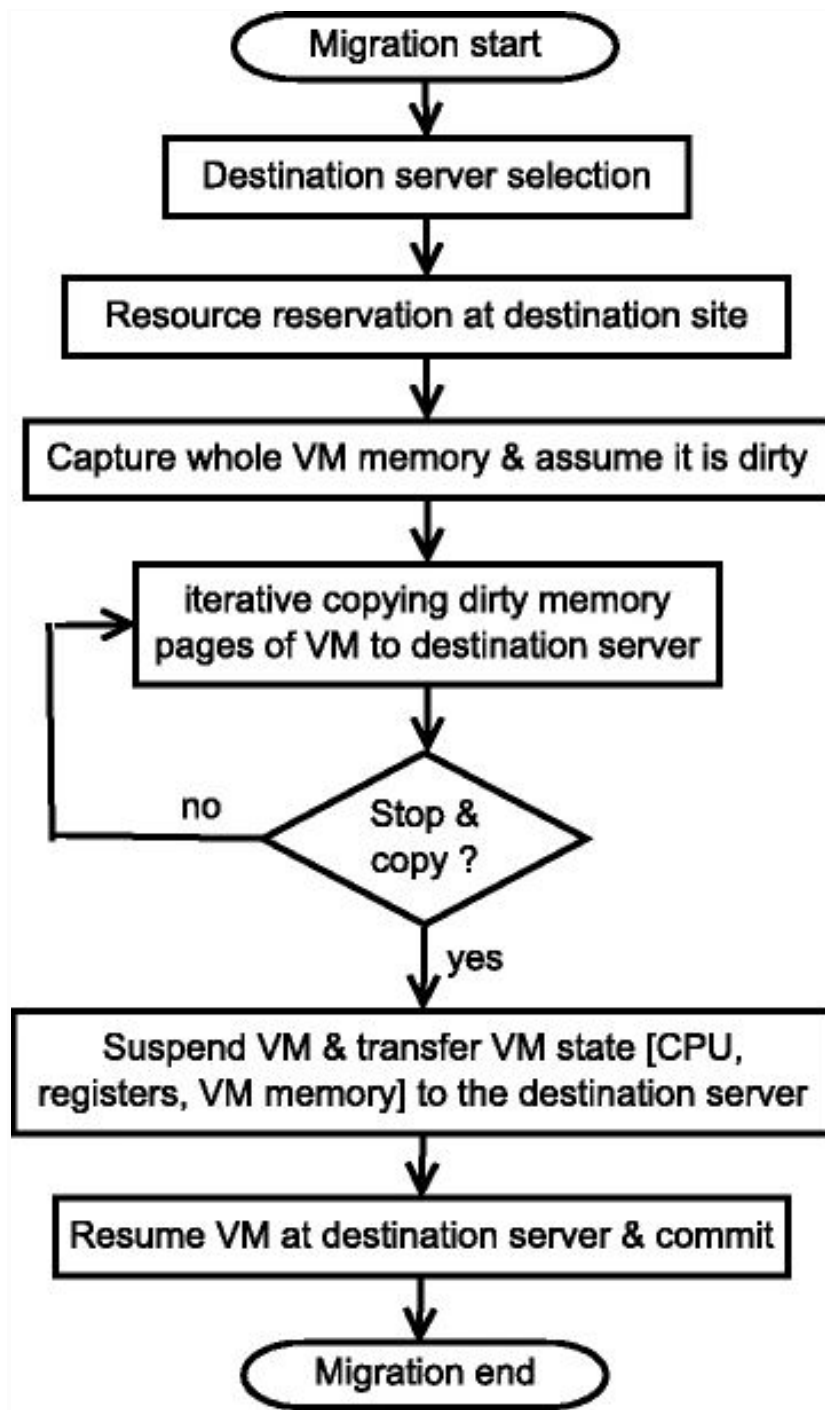


## **CHAPTER-3**

# **TECHNIQUES**

### **Pre-copy techniques**

The pre-copy technique uses iterative push phase that is followed by stop-and-copy phase as shown in Figure in the flow chart form. Because of iterative procedure, some memory pages have been updated/modified, called dirty pages are regenerated on the source server during migration iterations. These dirty pages resend to the destination host in a future iteration, hence some of the or frequently access memory pages are sent several times. It causes long migration time. In the first phase, all pages are transferred while VM running continuously on the source host. In a further round, dirty pages will resend. The second phase is termination phase which depends on the defined threshold. The termination is executed if any one out of three conditions meet: (i) the number of iterations exceeds pre-defined iterations, or (ii) the total amount of memory that has been sent or (iii) the number of dirty pages in just previous round fall below the defined threshold. In the last, stops-and-copy phase, migrating VM is suspended at source server, after that move processors state and remaining dirty pages. When VM migration process is completed in the correct way then hypervisor resumes migrant VM on the destination server. KVM, Xen, and VMware hypervisor use the pre-copy technique for live VM migration.

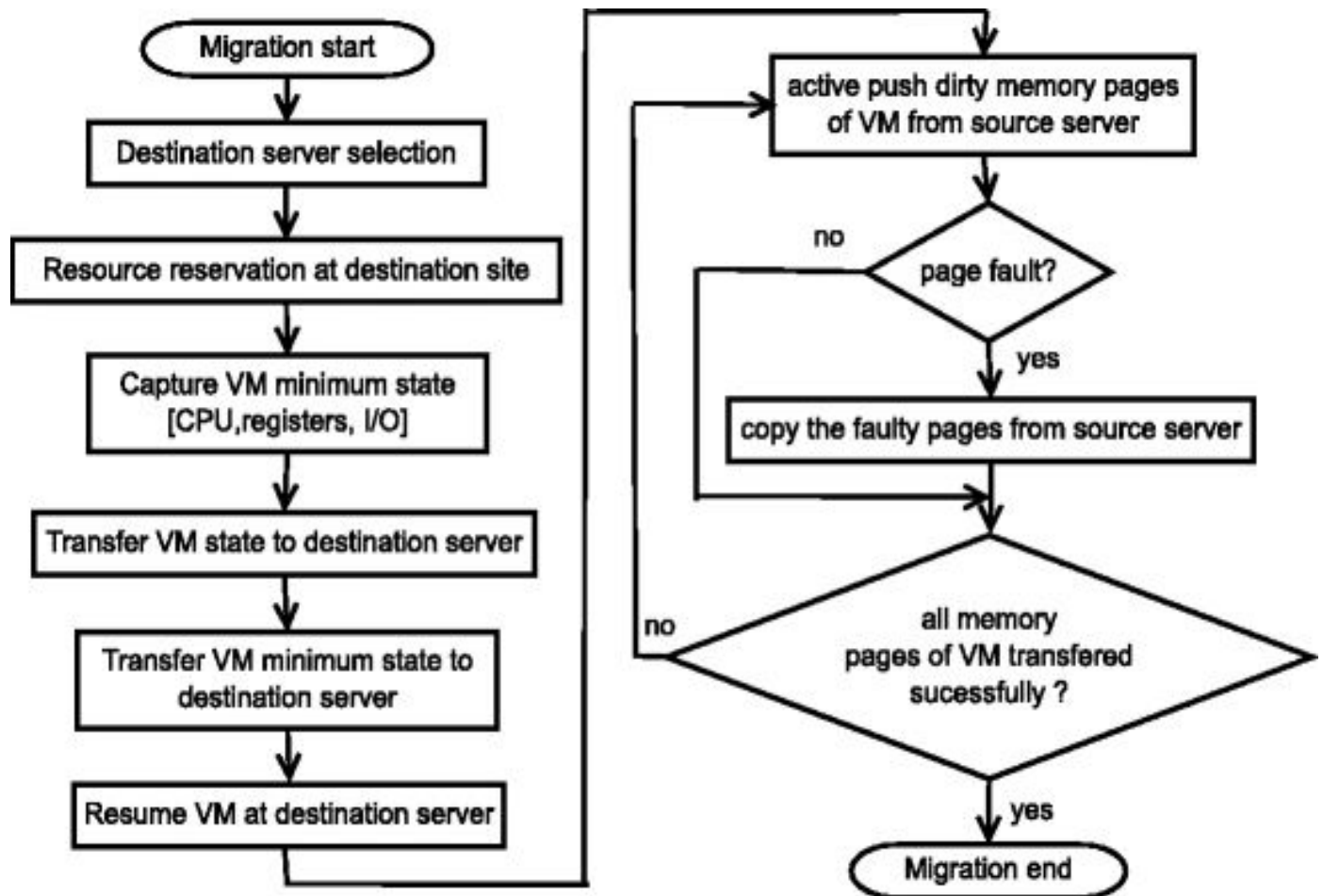


Basic steps of VM migration follow in pre-copy technique

## **Post-copy techniques**

In post-copy migration technique, processor state transfer before memory content and then VM could be started at the destination server. To optimizing live migration of VM's, Hines proposed post-copy technique. Post-copy VM migration technique investigates demand paging, active push, pre-paging, and Dynamic Self-Ballooning (DSB) optimization's approaches for pre-fetching of memory pages at the destination server. Post-copy has the ability to minimize network page faults, by pushing future requested pages from the source server before they are faulted by running VM. for this active push approach used with adaptive pre-paging. Michael R. compare the performances of the post-copy and pre-copy technique using Xen hypervisor. The results show that different migration metrics like total migration time, pages transferred, and network overhead has improved, VM having a range of workloads. To avoid sending of all duplicate pages, the post-copy technique is used with adaptive pre-paging.

The post-copy technique is effective when the majority of pages are transferred to target server before page faulty occur at destination VM and minor page faults occur due to network faults.



Basic steps of VM migration follow in post-copy technique

**Comparison table of pre-copy and post-copy based on Performance metrics**

<b>Performance metrics</b>	<b>Pre-copy technique</b>	<b>Post-copy technique</b>
<b>Preparation time</b>	It includes all the modified pages in iterative memory copying phases	Negligible
<b>Downtime</b>	It includes transferring any remaining dirty pages	It includes transferring another minimal execution state
<b>Resume time</b>	Re-schedule the target VM at the destination server and remove the memory pages at the source server	Majority of post-copy approach transfer the VM state and most of the memory pages in this period
<b>Pages transferred</b>	Transfer number of pages during preparation time period	Transfer number of pages during resume time period
<b>Total migration time</b>	More	Less
<b>Performance degradation</b>	High due to the tracking of dirtied pages for write-intensive workloads	High due to servicing of faulty pages

## **CHAPTER-4**

### **Conclusion and Future work**

VM migration can serve as a powerful tool for adjusting workload placement in a dynamic manner to achieve a variety of resource management objectives, including load balancing, server consolidation, improving data and communication locality, reducing energy consumption, as well as supporting mobile applications.

Live Migration is the best method of migration, that reduces downtime and increases quality of service.

Pre Copy Migration and Post Copy Migration each have their use cases.

Post Copy has greater efficiency but state is distributed between source and destination. So it can be used when both source and destination are reliable and efficiency is the highest priority.

Pre Copy retransmits pages but has an up-to-date state at the destination, so it can recover the state of the VM in case of failure.

In our future work, we will propose a novel approach which would be able to reduce service downtime and total migration time. We will also optimize the migration technique in the hypervisor to improve the performance of the live VM migration

## **References:**

- Live Virtual Machine Migration Techniques: Survey and Research Challenges- Divya Kapil, Emmanuel S. Pilli and Ramesh C. Joshi
- Cost of Virtual Machine Live Migration in Clouds: A Performance Evaluation -William Voorsluys<sup>1</sup> , James Broberg<sup>1</sup> , Srikumar Venugopal , and Rajkumar Buyya
- A Comprehensive Review of Virtual Machine Migration Techniques in Cloud Computing- Suruchi Talwani, Jimmy Singla
- Review on Various VM Migration Techniques-Vinay Katoch,Uday Chourasia
- Virtual Machine Migration in Cloud Computing-Pankajdeep Kaur and Anita Rani
- T. Wood et al., “Black-Box and Gray-Box Strategies for Virtual Machine Migration,” Proc. 4th Conf. Symp. Networked Sys. Design & Implementation, 2007
- Jie Zheng, Tze Sing Eugene Ng, and Kunwadee Sripanidkulchai. Workload-aware live storage migration for clouds
- A.Singh, M. Korupolu, and D. Mohapatra, “Server storage virtualization: integration and load balancing in data centers,”
- A Survey of Virtual Machine Migration Techniques in Cloud Computing Sandeep Kaur, Prof. Vaibhav Pandey Department of Computer Science and Engineering, Punjab Institute of Technology, kapurthala Punjab, India
- A Virtual Machine Migration Strategy Based on Time Series Workload Prediction Using Cloud Model Yanbing Liu,<sup>1</sup> Bo Gong,<sup>1</sup> Congcong Xing,<sup>2</sup> and Yi Jian.
- Energy-aware Virtual Machine Migration for Cloud Computing - A Firefly Optimization Approach Nidhi Jain Kansal · Inderveer Chana

