Chapter 21
A Practical Approach on Virtual Machine Live Migration

Prashanta Kumar Das
ITI Dhansiri, Assam, India

ABSTRACT
Virtualization technology enables organizations to take the benefit of different services, operating systems, and software without increasing their IT infrastructure liabilities. Live migration of virtual machine is the key features of the virtualization. It allows the administrator to move the virtual machine from one physical machine to another physical machine without any interruption. This technique is widely used for load balancing, server maintenance, and resource consolidation. The virtual machine migration problem consists of four distinct steps. The first step is to select the host from where VM migrated. After selecting, the next step is to select the VM, which is migrated. The third step is to select the host where the migrated VM will be placed, and the last step is to decide the method, which is used to transfer the VM. This chapter covers all the basic information related to VM migration.

INTRODUCTION
Cloud can be deployed in three ways i.e. Private, Public and Hybrid cloud (Wind, 2011), (Sarathy, Narayan & Mikkilineni, 2012). Cloud services are broadly classified into three categories Software as a service (SaaS), Platform as a service (PaaS), and Infrastructure as a service (IaaS). SaaS provide the software as a service. Its allow the user to access the software without installing them on the users machine such as Google doc. PaaS provide the complete platform to the developer for developing the application. Amazon EC2 and Microsoft Azure provide PaaS. IaaS is the delivery of computer infrastructure (Server, data center, network, virtualized environment) as a service to the client. These services are available to the client in a “pay-as-you-go” model.

Virtualization is the key technology behind the cloud computing, which allow multiple OS to run on a single physical machine. In the cloud computing, all computing resources are provided to the client through virtualization. It increases the resource utilization because multiple users can use same hardware. Virtualization is implemented through the hypervisor also called virtual machine monitor (VMM). Hypervisor is a software layer, which manages all virtual machine and separates
the virtual hardware from the actual hardware. Each user has their virtual machine created on the basic of their requirements. Each virtual machine has its own resources and number of virtual machine can run on a single physical machine.

One of the important features of the virtualization is the live migration. Live migration is a process of transferring the virtual machine from one physical machine to another physical machine. Since load on the virtual machine can change dynamically, hence there is a possibility that the current physical machine will be unable to fulfill the resource requirement of the virtual machines (Mell & Grance, 2011). This problem can be solved to some extent by adding the extra hardware resources in the physical machine or by migrating virtual machine to another server having sufficient resources.

The second option i.e. migrating virtual machine to another server having sufficient resources is found to be very cost effective.

Live migration of the virtual machine is useful in the event of server failure, server maintenance, load balancing, hot spot mitigation, and servers consolidation. This chapter discusses about some of the well-known approaches used to find the resource requirement of the virtual machine, select the target physical machine, and transfer the virtual machine (Armbrust, Fox, Griffith, Joseph, Katz, Konwinski, Lee & Patterson et al., 2010).

**VIRTUAL MACHINE MIGRATION**

Transferring of a virtual machine from one physical machine (server) to another physical machine is called virtual machine migration. Down time and total migration time are the two metric, which define the effectiveness of the migration algorithms. Downtime is defined as the time for which service of the virtual machine are not available to the user.

Total migration time is time duration between the migrations initiated at the source to the time when the migrated virtual machine gets a consistent state with the original state at the destination. Downtime and total migration time both should be minimum possible for effective migration (SearchServerVirtualization, 2014).

**Virtual Machine Migration Techniques**

Virtual machine migrations are classified into two types:

- Pre-copy migration
- Post-copy migration

**A. Pre-Copy Migration**

It is an iterative method of the live migration. In the first round, all memory pages and CPU states are transfer to the destination virtual machine. Since virtual machine still run the source virtual machine, so during the transmission some memory pages are modified. These modified pages are called dirty page.

Set of dirty pages are called writable working set (WWS). Set of dirty pages in the previous round are transferred into the next round. This process is repeated until the size of WWS is reduce to 1 MB.

The next step is to stop the virtual machine on the source and transfer all memory pages and CPU states to the destination virtual machine.

Finally, start the virtual machine on the destination as shown below.

VM migration consists of three parts.

**B. Post-Copy Migration**

In this approach, virtual machine is stopped on the source, instead of transferring the all memory pages and CPU states. Hence, this approach of virtual machine migration transfers the minimum memory pages and CPU states required to initialize the virtual machine on the destination. Remaining memory pages and CPU states are copied through the demand paging. Hence, this approach of VM