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Live Virtual Machine migration: A Performance Test Xen and KVM

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Abstract— Virtualization technology has many important features such as live virtual machine migration. In live virtual machine migration, a power on virtual machine is moved from one physical host to another. It has various benefits such as server consolidation, proactive failure, load balancing, energy saving and resource scheduling. Live virtual machine migration is very useful tool in cluster environment, administrators of data centers and in cloud environment. Live virtual machine migration is supported by hypervisors such as Xen, KVM, VMware etc. In this paper we discuss live virtual machine migration Pre-Copy approach which is a default approach in many hypervisors. We compare the performance of virtual machines which are made using Xen and KVM. We also compare performance when virtual machines are migrate using Xen and KVM in cloudreport simulator. In result we find that KVM performs better than Xen.

Keywords—Virtualization, Live virtual machine migration, Pre-Copy approach, Xen, KVM

I. INTRODUCTION

Virtual machine migration is an important feature of virtualization which moves running virtual machine between distinct physical hosts without disconnecting with users. During the VM migration, memory contents and local file systems are transferred without shared storage. Using shared storage, no need to transfer local file system.

Pre-Copy approach process, in live migration, firstly all the memory pages are marked as dirty and numbers of rounds are acted. In first round the memory pages are moved and, in each round, the memory pages dirtied during previous iteration has to be resent. At source, virtual machine is paused when the number of dirty pages is less than a certain threshold, Virtual machine is paused at source and then rest of dirty pages and CPU's state are moved and Finally, at destination virtual machine is restarted. Pre-copy approach which transfers memory contents and CPU's state. Most of the standard hypervisors such as Xen, KVM and VMware use the precopy technique as default.

In pre copy algorithm iterative push phase are performed which are followed by stop and copy phase. Dirty pages, which are modified memory pages, are generated at the source because of iteration and these dirty pages must be resent to destination as pages are transferred many times. Due to it, migration time can be long. First phase is Pre copy phase in which from source to destination memory pages are moved iteratively and virtual machine runs continue. Some pages get dirtied and they need to be resent in next iteration. In next phase, called termination phase one of the thresholds is taken which is based on a predefined number of iterations, amount of memory which has transferred and the number of dirtied pages in previous round. The number of perform

Virtual machine is paused and CPU state and rest of dirty pages are copied in stop and copy phase which is the last phase. After completing migration process, virtual machine is restarted at destination host.

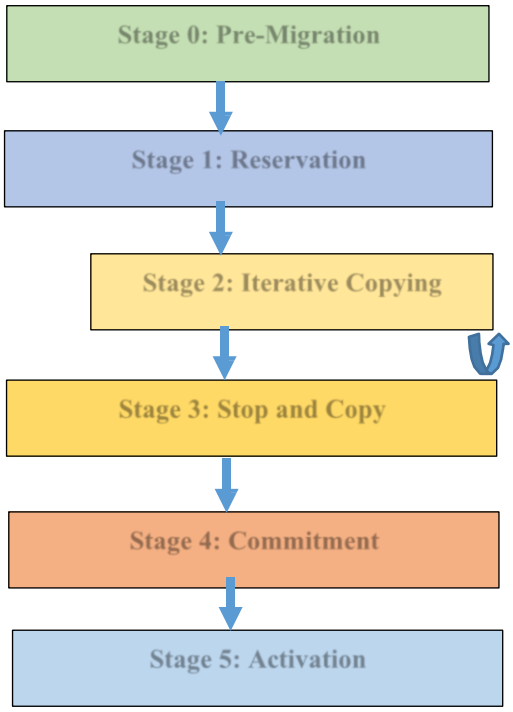

Figure 1 Precopy Approach [1]

Figure 1 shows the stages of virtual machine migration and Figure 2 shows the pre-copy timeline.

In section 2 we discuss some previous work of live virtual machine migration using Xen and KVM platform and also discuss about the Xen and KVM. In section 3, we describe the experiments with virtual machine and cloudreport and section 4 describes the results. And finally, we conclude our paper in section 5.

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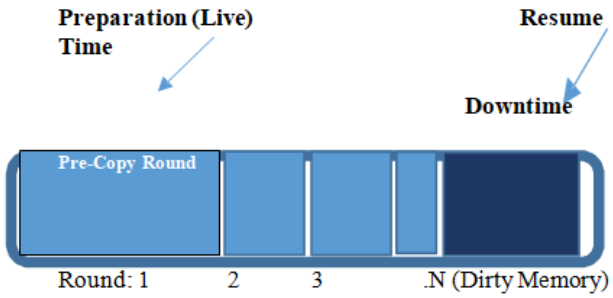

Figure 2 Pre-Copy Timeline

II. RELATED WORK

Various live migration technologies focused on improvement of migration efficiency for modern data center, clusters and cloud environment. We are categorizing live virtual machine migration previous work on the basis of hypervisors Xen and KVM in different environment like cluster, data center and cloud data center also comparing these technologies on the basis of their results. Results are based on the performance metrics total data transferred, downtime and total migration time. Table 1 shows the various technologies which use Xen platform and shows the results. Table 2 shows technologies which use KVM hypervisor.

A. *Live Virtual Machine Migration with Xen Hypervisor*

VM migration based on RDMA (Random Direct Memory Access) is proposed by Huang et al. [2] which reduce memory pages transfer time. While migrating the virtual machine over TCP / IP, it face the problem of lower transfer rate. Akoush et al. [3] proposed a prediction model which predict the workload specific service interruptions and they examine migration times. To provide fast virtual machine migration Jin et al. [4] used memory compression (MECOM) based VM migration approach. Xen hypervisor was used and in result downtime, total transferred data and total migration time are reduced. H. Liu et al. [5] proposed the first model which costs VM migration in terms of both performance and energy. Liu et al. [6] implemented CR/TR-Motion which is a fast, transparent virtual machine migration, it reduced down time and total migration time. It also reduces the consuming of less network bandwidth. Liu et al. [7] combined technology of recovering system (check pointing / recovery and trace / replay) with CPU scheduling. They used CPU scheduling to reduce downtime. In result downtime and total migration time both are reduced. Al-Kiswany et al. [8] proposed VMFlockMS, a migration system which is optimized for VMFLocks which are VM images which belong to the same application. Fei Ma et al. [9] proposed a new approach of pre-copy technique in which a bitmap page is added which marks frequently updated pages. They used Xen 3.3.0 hypervisor and performed migration in cluster environment.

Platfor	Paper	Environmen	Result
Xen	Migration with RDMA [2]	Cluster	Total Downtime: Reduced by 77%
			Total Migration Time: Reduced by 80%
	Prediction based migration [3]	Data Center	Total Migration Time: 90% accurate
	MECOM [4]	Cluster	Data Transferred: Reduced by 68.8%
			Total Downtime: Reduced by 27.1%
			Total Migration Time: Reduced by 32%
	Performance and energy model [5]	Data Center	Migration cost reduced by 72.9 % and 73.6 % energy saving
	Full system trace and replay [6]	Cluster	Total Downtime: Reduced by 66.12%
			Total Migration Time: Reduced by 43.84%
	Recovering system and CPU Scheduling [7]	Cluster	Total Downtime: Reduced by 66.12%
			Total Migration Time: Reduced by 43.84%
	VMFlock[8]	Cloud	Data Transferred : Reduced by 3
	Improved Pre-copy Approach [9]	Cluster	Data Transferred: Reduction by 34 %
			Total Migration Time: Reduced by 32.5%

B. *Live Virtual Machine Migration with KVM Hypervisor*

Hacking and Hudzia [10] proposed a system which support transparent migration of large enterprise applications workloads This system aims to increase transfer performance and reduce down-time. Ibrahim et al. [11] presented a new algorithm that was implemented in KVM and reduces both downtime and performance of application. Svard et al. [12] implemented a live migration algorithm in KVM hypervisor in which they used delta compression. Due to delta compression technique, the reduction in the amount of data which is to be transferred and the throughput of migration is increased. Svard et al. [13] proposed a dynamic page transfer reordering technique in which the memory pages order are adapted dynamically and implemented the combined page transfer reordering algorithm with compression algorithm.

They modified the KVM hypervisor. Deshpande et al.[14] present the approach to perform simultaneous live migration of co- located VMs, i.e. in cluster environment, based on de- duplication. Reducing the total time of migration and network traffic. They used the Linux platform of QEMU / KVM to migrate virtual machines to live gangs. Deshpande et al.[15] address the issue of optimizing multiple VMs live inter-rack migration (IRLM), i.e. simultaneously moving live VMs from one system rack to another rack. During migration, the transferred data amount can be reduced by IRLM.

Platfor	Paper	Environmen	Result
KVM	Live Migration Process of large Enterprise Applications [10]	Data Center	Reduction in transferred data
	on-line algorithm [11]	Data Center	Total Downtime: Minimal
	delta compression live migration [12]	Cloud	Total Downtime: Minimal
	Dynamic page transfer recording and compression [13]	Cloud	Data Transferred: Reduced by 51%
			Total Downtime: Reduced by 10 to 20 factor
			Total Migration Time: Reduced by
	live gang migration [14]	Cluster	Reduction in transferred data
	inter-rack live migration [15]	Data Center	Data Transferred: Reduction by 26 %

Table 2

C. *Hypervisors*

i. *Xen*

Virtualization of operating systems is used in many different computing areas. For virtualization *hypervisor* is used. Xen, KVM, VMware, VirtualBox are the examples of hypervisor. The Xen hypervisor is an open-source software system which is used to manage the low-level interaction between virtual machines and hardware. There is one or more virtual machines (domains) running on the physical machine. Virtual machines are running operating systems and their software. Xen also facilitates "live migration," with virtual machines traveling across a LAN between physical hosts without loss of availability.

Xen features allow the simultaneous execution of multiple virtual machines on the same physical machine. Xen is a hypervisor in native or bare metal. Dom0 is the only virtual machine that has direct access to hardware by default. It is possible to manage the hypervisor from the dom0 and to activate unprivileged domains ("domU"). Xen is a hypervisor of open source hypervisor for x86-compatible computers.

ii.*KVM*

KVM (Kernel-based Virtual Machine) [17] is developed by Qumranet, Inc and was merged with upstream mainline Linux kernel in 2007. which runs virtual machines. KVM is open source and implemented as a kernel module and full virtualized hypervisor. The kernel is converted into a bare metal hypervisor in KVM.

III. EXPERIMENT

The goal of our experiments is to check the performance of the Xen and KVM hypervisor.

EXPERIMENT 1

In our first experiment we create virtual machine then check the CPU usages and memory usages. We installed Centos 5.5 as a host operating system on the physical host and install Xen on it. Then We created virtual machine. We used Centos 6.3 operating system as a guest operating system (VM).

In other system, we installed Ubuntu 11.10 as a host operating system on the physical host and install KVM on it. We created virtual machine. We used Windows XP professional as a guest operating system (VM).

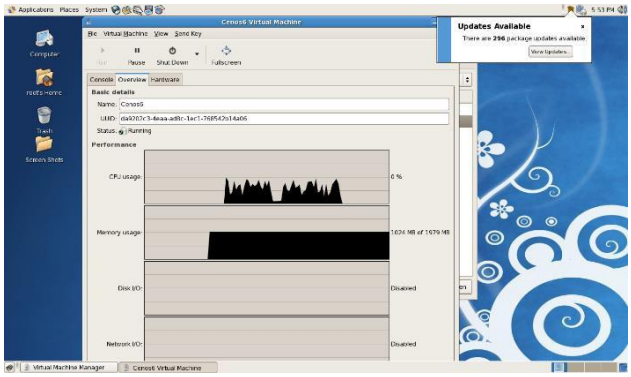

Figure 3

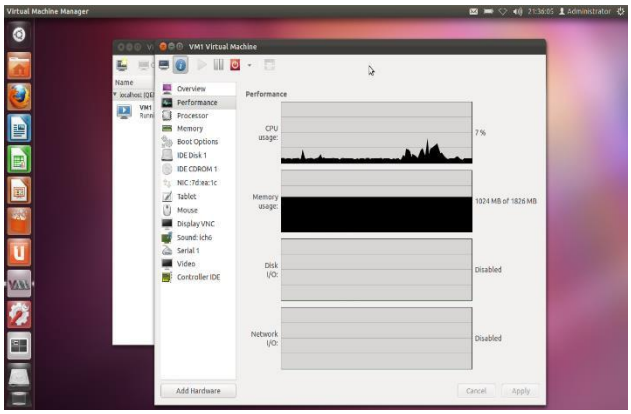

Figure 4

Experiment 2

Hence to get the migration results we are using a cloud simulator, cloudreport [16].Cloudreport is a cloud computing based graphic simulator that simulates distributed computing environments. Cloudreport has CloudSim as its simulation engine and it has graphical interface. Cloudreport generates the report. Cloudreport shows migration results for both hypervisors (Xen and KVM).

Figure 5 shows the migration using Xen hypervisor and Figure 6 shows migration using KVM hypervisor.

Figure 5

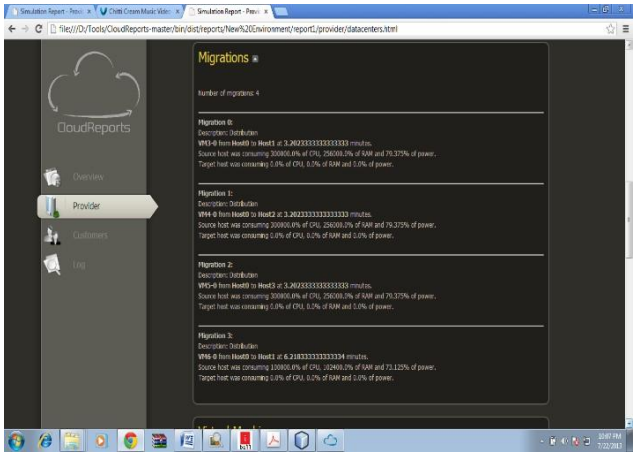

Figure 6

IV. RESULTS

A. *Comparison between performance of Xen and KVM*

Figure 3 and Figure 4 are showing the performance of virtual machines of Xen and KVM respectively.

Performance is based in the CPU and memory usage. In Table 3 we are showing the performance comparison of these virtual machines.

Virtualization Technology	Performance		Live Virtual Machine Migration
	CPU Usage	Memory Usage	
Xen	0%	1024 MB of 1979 MB	Yes
KVM	7%	1024 MB of 1826 MB	Yes

Table 3

B. *Live virtual machine migration using cloudreport*

In table 4, we compare the Xen and KVM on the basis of migration results.

Virtualization Technology	Number of Migration	Virtual Machine	Source Host	Destination Host	Migration Time (Min.)
Xen	4	VM3-0	Host 0	Host1	3.25
		VM4-0	Host 0	Host2	12.85
		VM5-0	Host 0	Host3	12.85
		VM6-0	Host 0	Host4	12.85
KVM	4	VM3-0	Host 0	Host1	3.20
		VM4-0	Host 0	Host2	3.20
		VM5-0	Host 0	Host3	3.20
		VM6-0	Host 0	Host4	6.21

Table 4

In our result analysis, we see that in each migration KVM is performing better than Xen.

V. CONCLUSION

Live virtual machine migration is process which migrates virtual machine across distant hosts of data centers, clusters and cloud. Hypervisors such as Xen, KVM use pre-copy technique. Downtime, total data transfer and Total migration time are the performance metrics by which we can measure the performance of virtual machine migration. We compared two hypervisors Xen and KVM and measure the migration time. For this purpose, we used two physical hosts, at one host we installed Xen and create virtual machine of Centos 6.3 operating system and at another host we installed KVM and create virtual machine of Windows XP operating system. We compared virtual machines performance. To get the migration results, we used cloudreport simulator which shows migration for both hypervisors and compare these results and show that KVM performs better than Xen.

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