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An approach for VM Migration

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Abstract— **Virtual Machines(VMs) refers to the software implementation of a computer that runs its own OS and applications as if it was a physical machine(PM). Live migration of VMs allows a server administrator to move a running virtual machine or application among different physical machines without disconnecting the client or application. Total migration time and downtime are two key performance metrics that the clients of a VM service care about the most, because they are concerned about service degradation and the duration that the service is completely unavailable. When a VM is migrating, it is important that this transfer occurs in a manner that balances the requirements of minimizing both the downtime and the total migration time.**

Keywords— **Virtualization, Virtual Machine, Hypervisor, Virtual Machine Migration.**

I. INTRODUCTION

Virtualization is an approach that allows developers to create a snapshot or replica of the existing system, to create customized environment without compromising and making changes to available physical resources. The purpose of Virtualization is to utilize the resource sharing, utilization and distribution to their maximum potential, reduce infrastructure costs in terms of physical resources, hardware, new network setups, system setups, and infrastructure maintenance.

Virtualization hides the characteristics of the physical system from the user and instead provides with another abstract computing platform. Virtualization often finds itself as an alternative to run the applications that are not currently supported by the existing systems, evaluate new systems, run multiple instances of same or other alternate systems on same machine. Virtualization in broad terms comes in various forms like Para-virtualization, Full virtualization, and container-based virtualization. Virtualization further can be in various forms like Operating Systems, Applications and Storage level virtualization. In this paper we explore OS level virtualization in servers residing in big datacenters and related issues with them.

Virtual Machine

Virtual Machines (VM) go with the context of Virtualization in physical machines like desktop, servers, etc wherein a copy of the existing system is made either in view to dynamically map new systems with existing ones, increase number of users and system usage, test the new systems on existing infrastructure, resource distribution and sharing. A typical VM comprise of a guest Operating System (OS), guest application(s), with shared CPU cores, shared memory, shared NIC and shared disk drives over a physical machine comprising its own layers of hardware and software.

A Virtual Machine though was originally defined by Popek and Goldberg as "an efficient, isolated duplicate of a real machine [1]". The purpose of designing Virtual Machines is to

- Allow existence of strongly isolated multiple OS on the same computer.
- Provide an instruction set architecture (ISA) that is somewhat different from that of real machines [1].
- Testing new developments, application provisioning, system maintenance, increased availability, storage transfers.

The major disadvantages that comes with any VM includes their low efficiency in comparison to physical machines due to indirect instruction execution and accesses, high dependence on physical resources like Memory, CPU processing speeds, current process execution speeds of processor, resource reservations, etc. But despite of these disadvantages Virtual Machines are still high in demands for deployment on existing systems and networks for workload distributions and accommodate fast growing business requirements and end-users.

Virtual Machine Migration

Term "migration" in general states the movement or passage of a person from one locality to another. In terms of Computers and Networking, migration presents the movement of a system from one location or one network to another. VM Migration thus is a process performed between two or more physical servers deployed over a Local Area Network (LAN) or Wide Area Network (WAN) in which a Virtual Machine is moved from one machines to another often in context to server maintenance, load balancing, efficient resource sharing, network scalability, testing, storage back-ups, server management, disaster recoveries, etc.

With the growing data day by day and advancements in application processing and networking, Virtual Machines and their migrations are becoming major needs of any business today.

II. VIRTUAL MACHINE ARCHITECTURE

Since a Virtual Machine comprises of its own Operating System and shared hardware, it resides independently, in isolation on a physical machine and executes over a Virtual Machine Monitor (VMM) or hypervisor. VMM is a Virtualization software designed to make virtual machines which constantly monitors the VMs running over it. It acts as a bridge between these VMs and physical machines' hardware/software.

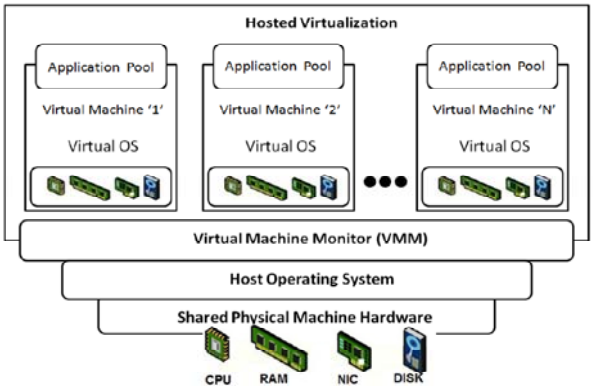


Fig. 1 Virtual Machine architecture for a server

Figure 1 above demonstrates a simple VM architecture for a Datacenter Server machine. Starting from the bottom of the logical stack, the host operating system (any server OS like Windows Server 2008) manages the physical computer. The Virtual Machine Monitor (VMM, also known as Hypervisor) acting as a virtualization layer that manages virtual machines, providing the software infrastructure for VMs hardware emulation by sharing server resources. Each virtual machine consists of a set of virtualized devices. When a guest operating system is running, the special-purpose VMM kernel manages the CPU and hardware during virtual machine operations, creating an isolated environment in which the guest operating system and applications run close to the hardware at the highest possible performance rate.

III. VM MIGRATION STRATEGIES

Virtual machine migration includes two modes: non-live VM migration and live VM migration. In non-live VM migration, the execution of the VM is suspended during whole migration process [3]. During live migration process for VMs, the VM on source server which is to be migrated keeps running during most of migration time. The two categories of live migration algorithms include: Pre-Copy (with stop-copy-resume) and Post-Copy of VM storage.

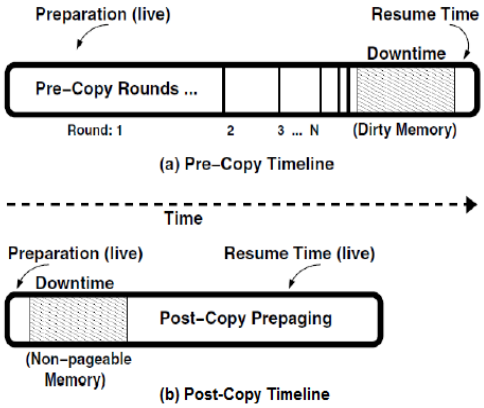


Fig.2. (a) Pre-copy and (b) Post-copy migration strategies

Pre-Copy is the more frequent and common live migration technique to perform live migration of VMs. Using Pre-copy, the storage memory of the migrated VM is copied to destination host first while the VM is still running on the source host. The source host maintains the newest memory image until migration is finished as can be seen in Fig.5(a) below where vRAM, vCPU and vDISK are the virtual RAM, virtual CPU and virtual Disk respectively, allocated to a Virtual Machine on a physical machine for its operation and execution. At the end of Pre-copy migration phase, the VM is suspended and the remained memory image is copied to destination host. The remaining new memory images are called Dirty Memory. This technique of migration usually results in redundant dirty pages at destination host which are generated till the time VM is suspended at the source. As a result, the migration time for extra page delivery increases. This phase is known as Stop & Copy migration phase. The migration itself encompasses transfer of the persistent state of the VM (i.e. its file system), transfer of the volatile state of the VM i.e. RAM contents and CPU state, and the redirection of network traffic. Once the state transfer is complete, the VM continues to run in the new physical machine, known as VM resume phase.

In Post-Copy, it works in two phases: [4,5] (Fig.5(b)) In the first phase, VM is suspended on the source host, and its VCPU context and minimal memory work-set is copied to destination host. In the second phase, VM is started on the destination host, and the remained memory image is continued transfer to destination host. Though it saves the migration time initially but then the frequent requests for disk dirty pages for old data to the source increases the load on the server as well as to the communication further. Under Post-copy migration the page fetching handling is done in various schemes: Post-copy via Demand Paging, Post-copy via Active Paging, Post-copy via Pre-paging.

IV. MAJOR HYPERVISORS

With large popularity of VM and migrations worldwide, many big IT business leaders came out with their solutions to implement the powerful technologies to support integrated system creations. Virtualization support companies like VMware, Microsoft brought down into market their own hypervisor solution systems in order to create a abstraction layer between physical machines and virtual machines in their datacenters. Different companies made different hypervisors with varied functionalities but with a common functionality of VM migrations. Following companies brought the following Open-source and licensed software:

- ***VMware:*** VMware Inc., the leader in virtualization market designed a complete infrastructure solution for Virtualization in datacenters. That includes ESXi server hypervisor on which virtual machines are created, vMotion with vCenter for VM migration process initiation and completion and central storage communication in the form of iSCSI/NAS.
- ***Microsoft:*** Microsoft corporation for its datacenter designed hypervisor named MS Hyper-v with NAS for multiple VM migrations at the same time.
- ***XEN:*** the oldest Virtualization technology developer designed XEN-Motion to support para-virtualization technology for the systems to keep the VMs highly isolated from each other when deployed on a host with low penalties for performance. Additionally, in XEN-

based systems guest VMs know the hypervisors and run efficiently without virtual emulated hardware.

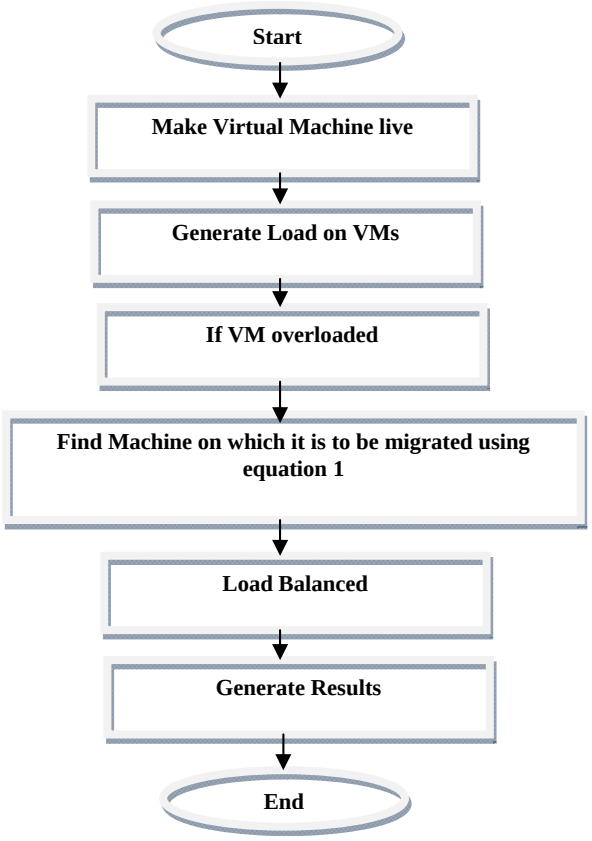
- ***KVM:*** Kernel based Virtual Machine, works on full virtualization of hardware technology that add virtualization capabilities to a standard Linux kernel and along with dedicated QEMU process, the emulation of the VMs on host machines is carried out considering them as Linux process running in guest mode. Therefore no guest VM modifications for its execution are required on new physical machine to which it is migrated.
- ***OpenVZ:*** OpenVZ along with Parallels Computer Servers offers a solution for VM migration. It works on container-based virtualization for Linux systems and creates secured containers which act as independent server on physical machine to get better server utilization and resource availability.

V. APPLICATION AREA

Virtual Machines together with VM migration facility are finding their existence in many area of business today. Be it Information Technology, finance, health-care, daily lives, or else, businesses" are more and more inclining towards virtualization to meet ever changing requirements. Following are some application area of VMs with migration:

- *Cloud Computing*
- *IP-TV and DTH networks*
- *Storage Area Networks (SAN)*
- *Data warehousing and Big Data*
- *Social Networking and e-Mails systems, etc.*

VI. PROPOSED WORK



Pr(i) = t* Tc(i) + s* Tm(i) + utilization/Power

Where (1 i n) and t + s = 1

Pr= Priority of each virtual machine node,

Tc = CPU speed (MIPS),

Tm = memory resource,

t = the CPU weight,

s = the weight of memory

VII. RESULTS AND DISCUSSION

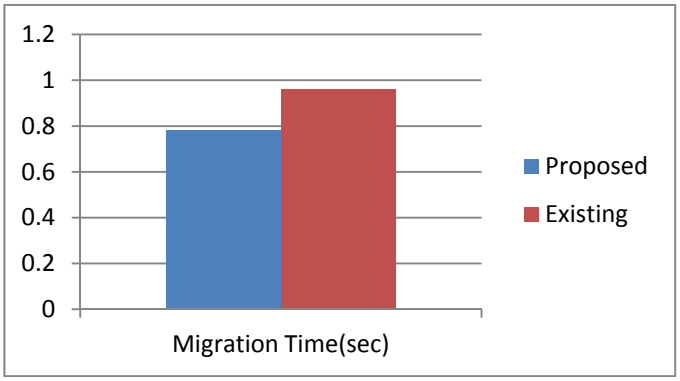


Fig 3: Migration time

Figure 3 defined about the Migration time in existing and proposed approach. Migration time in the proposed approach is 0.79 sec where as in vector dot it is 0.9 sec.

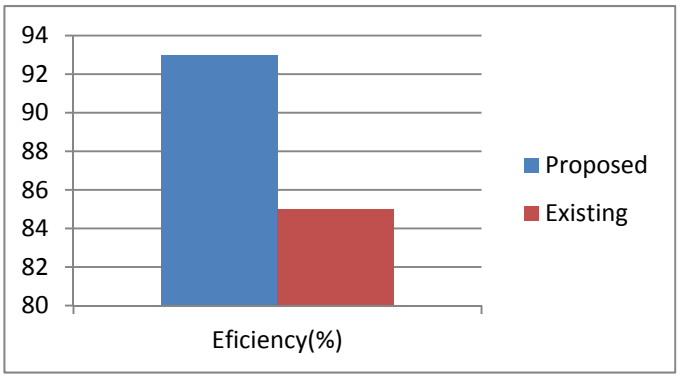


Fig 4. Efficiency

Figure 4 defined about the efficiency of the existing and proposed approach i.e. 93% in proposed and 85% in existing approach.

VIII. CONCLUSION

Research in the field of Virtualization has been in existence for more than a decade now as not only the technology is best suited for scaling demands for the IT infrastructure, it reduces the overall expenditure on infrastructure developments and the maintenance thereafter. With developments in Virtual Machines design technology for both hardware and software, it now became easy to deploy new systems on existing ones without any hefty additional costs, maintain them, test new developments and provide best of the class service in potential application areas of Virtual Machines with migration process.

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