A Comparison and Evaluation on Virtualization Tools for Cloud Environment

Dr. Ghanshyam Parmar,

Assistant Professor,

Natubhai V. Patel College of Pure and Applied Sciences, Vallabh Vidyanagar, India

Abstract: **Virtualization is becoming progressively widespread, for both servers as well as desktop systems. Numerous studies have been undertaken to scrutinize the influence that virtualization has on system performance. In this paper, we acquaint with a comparison and evaluation on Virtualization Tools of desktop application performance between VMware Workstation and Oracle's VirtualBox using their features, programming language supported for develop application to construct private or public cloud and managing hypervisors. As an assumption, both virtual machines imposed a performance impact upon the systems. As an unexpected outcome might be that the both open source VirtualBox as well as licensed application VMware Workstation performs well in commercial market. However, for getting the features for enterprise user must purchase commercial software from VMware.**

Keywords: Virtualization, Virtualization tools, Emulation, Para-virtualization, Full Virtualization, OS – level Virtualization, VMMs.

I. INTRODUCTION

Virtualization refers to the creation of virtual instances of the existing hardware that acts as a physical computer with its own operating system. It is based on the principle of software and hardware equivalence. The operating system and software that are running or executing on the virtual machines are separated using Virtual Machine Monitor (VMM) from the resources of physical machine. For example, a computer system with Microsoft Windows as operating system. Which has VMM, in that one virtual machine has an operating system called Ubuntu Linux. In that Ubuntu supported software and programs can be installed and execute on that virtual machine.

The virtualization is done on the actual or physical machine is called host machine, and the guest machine is called the virtual machine. For differentiate the physical and virtual machine the terms host and guest is used. To create virtual machine on host or physical machine the Virtual Machine Monitor is used which is a software or firmware. [1]
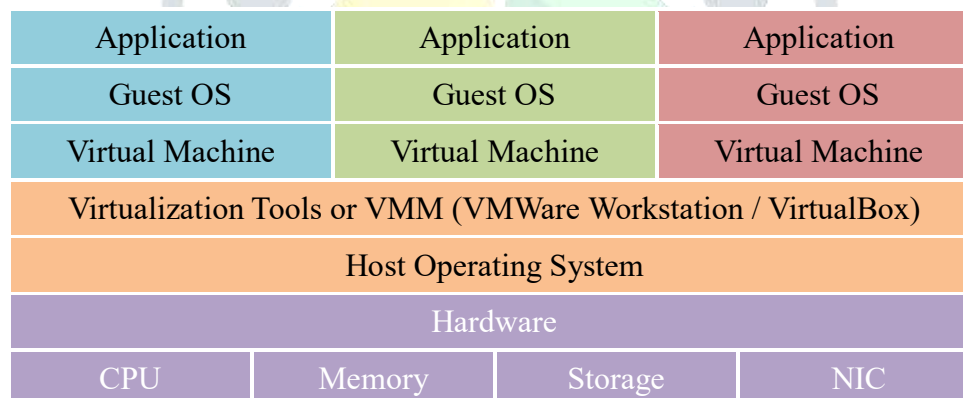

Fig. 1 Basic Architecture of Virtualization

Terminologies of Virtualization:

Host operating system (Host OS):

The physical machine or computer contains operating system which is called host OS in that Virtual Machine Monitor software is installed. [5]

Guest operating system (Guest OS):

The operating system installed in VM is called guest OS. Generally the VMM can run easily on any x86 operating system such as DOS, Windows X, OS/2, FreeBSD, and OpenBSD. For other OS like MAC or Linux some optimizations are needed in OS. [5]

Virtual Machine (VM):

A virtual machine (VM) is an emulation of a particular computer system. The Virtual machine works based on the architecture of computer system and functions of a physical or imaginary computer, and their applications may involve dedicated hardware, software, or both. [10]

The VMs cane be classified based on the functionality of implementation of the physical machines. So, the virtual machine provides a complete surplus of physical machine and same level of functionality for executing the complete operating system also known as Full Virtualization Virtual Machines. [10]

Types of Virtualizations:

Emulation:

The complete hardware of computer system is simulated in Virtual machine and it allows to execute unmodified operating system. The virtualization tool supports emulation is Microsoft Virtual PC, Bochs, and QEMU.

Para-Virtualization:

It is a virtualization technique which permits similar software interface to the virtual machine but not as equal as the original hardware of physical machines. Here the modification of operating system is required. A successful para-virtualized platform may allow the virtual machine monitor (VMM) to be simpler if it execute the critical tasks in to the host OS instead of guest OS. [9] The virtualization tools support para-virtualization is Xen hypervisor, and VMWare ESX Server.

Full Virtualization:

Here the modification of operating system is not required therefore the virtual machine has to partially simulate enough hardware so that guest OS can run efficiently. One consideration is required for full virtualization is that the microprocessor supports guest OS. Full virtualization requires every salient feature of the hardware such as full instruction sets of machine, interrupts, access of memory, input / output operations, the software that can be run on underlying hardware of the machine that can be reflected into one or several virtual machines. The microprocessor invented after 2005 – 06 addition of the AMD-V and Intel VT-x can only support full virtualization. [8]

The virtualization tool supports full virtualization includes Adeos, Mac-on-Linux, Parallels Desktop for Mac, Parallels, Workstation, VMware Workstation, VMware Server (formerly GSX Server), VirtualBox, Win4BSD, and Win4Lin Pro. VMware.

Operating System Level Virtualization: To create multiple Virtual Machines (VMs) the operating system is divides in to several isolated partitions. The OS-level virtualization provides a virtual environment which can be instantly split from the operating system of host computer. In OS-Level Virtualization, several distinct user space instances, often referred to as containers, are run on top of a shared operating system kernel. [2] The beneficial part of the OS-level virtualization is the manageability, security and executing complex software environment. This reduces resources runtime overhead by minimal changes in existing infrastructure. The virtualization tool supports for full virtualization includes Solaris Containers, BSD Jails, and Linux Vserver.

II.   VIRTUALIZATION TOOLS: VMWARE WORKSTATION AND VIRTUALBOX

VMWare Workstation:

VMware Workstation is a hypervisor that runs on Intel 32- or 64-bit computers. It facilitates users to install one or more virtual machines (VMs) on a single physical machine, and use them concurrently along with the physical machine. Each virtual machine can execute its own operating system, including versions of Microsoft Windows, Linux, BSD, and MS-DOS. [7]
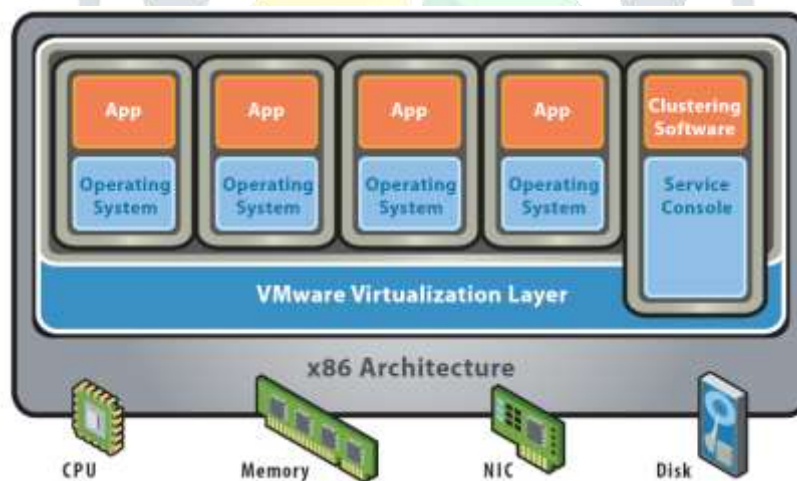

Fig. 2 VMware Architecture

Users can create bridge between the host network adapters and VMware Workstation by sharing drivers of physical disk and USB devices using VMs. In addition, it can simulate disk drives. VMWare supports various facilities such as simulation through mount an existing image file as type of ISO into a virtual disk drive where VMs understand it as a real disk, likewise, .vmdk files are used as virtual hard disk drives. [7]

The VIX API of VMware gives you the rich set of functions to manage VM operations like power on / off, clone, pause / resume on VMware vSphere, VMware Workstation, VMware Server, and ESX / ESXi hosts. In VIX API the set of functions are given into a library which contains scripts and programs to automate virtual machines. These scripts and programs are in high-level languages so it is, easy to use, easy to programming for script developers and application programmers. The VIX API is designed for three kinds of users: Technically Adventurous Users, Partners, and VMware Engineering. [6]

The VIX API supported operating systems are mainly Microsoft Windows and Linux platforms. In Windows and Linux the version supported are Windows-95 or later and 2.4.x kernel or later. The support of programming languages are C, Perl, and COM based langaues like VBscript, and C#. [01] For VMware Workstation 10 VIX API version 1.13 is supported.

Oracle's VirtualBox:

The microprocessors with the architecture of x86 and AMD-64 / Intel-64 which can be supported by the powerful virtualization software named as VirtualBox which is used in enterprise as well as for home use. VirtualBox is freely available as Open-Source Software under the terms of the GNU General Public License. [3]

There are currently many platforms are available in the market like for windows servers: NT 4.0, 2000, 2003 and others like XP, Vista, Windows 7, Windows 8 and Windows 10, Linux (2.4, 2.6 and 3.x), Macintosh, and Solaris hosts. [3]
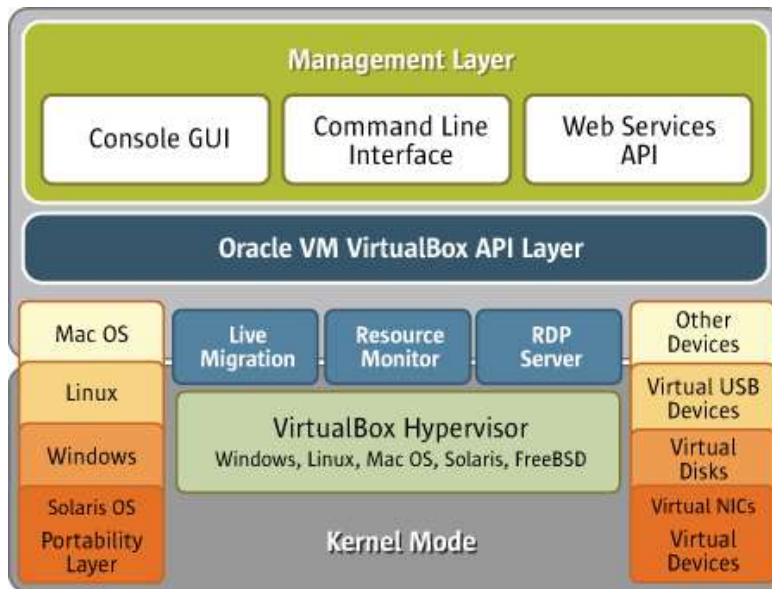

Fig. 3 VirtualBox Architecture

The web service of VirtualBox is practically maps with the entire Main API. Internally, for portability and easier maintenance, the Main API is implemented using the Component Object Model (COM), an inter-process mechanism for software components originally introduced by Microsoft for Microsoft Windows. [4]

So, if you are familiar with COM and the C++ programming language (or with any other programming language that can handle COM/XPCOM objects, such as Java, Visual Basic or C#), then you can use the COM/XPCOM API directly. [4]

III. FEATURE COMPARISON OF VMWARE WORKSTATION & VIRTUALBOX

VM Version	VMware Workstation
Features	Comments
Full Virtualization	Called 'VMware Tools,' allows for better mouse, video, and another I/O performance in a virtual environment
Operating System Support	Older Operating systems are also supported like Windows XP, Server 2003, Vista, Server 2008, and Windows 7. Best-in-class Windows 8 support. New Operating System Support: - Windows 8.1 - Windows 8.1 Enterprise - Windows Server 2012 R2 - Ubuntu 13.10 It supports all latest versions of Fedora, CentOS, Red Hat and OpenSUSE releases.
Controlling Virtual Machines	The VIX API helps you to write scripts to automate virtual machine operations and manipulate files within guest operating systems. VIX programs run on different systems and support management of vSphere, Workstation, Player, and Fusion. The VMWare SDKs contains a rich set of programmable interfaces that enable developers to manage VMs programmatically with an asynchronous, job-based programming model.

Programming Languages support for application development	C, Perl, Java, and COM (Visual Basic, VBscript, C#)
VM Version	**Oracle's Virtual Box**
Full Virtualization	Called 'Guest Additions,' allows for better mouse, video, and other I/O performance in a virtual environment
Operating System Support	Older Operating systems are also supported like Windows XP, Server 2003, Vista, Server 2008, and Windows 7. Best-in-class Windows 8 support. New Operating System Support: - Windows 8.1 - Windows 8.1 Enterprise - Windows Server 2012 R2 - Ubuntu 13.10 It supports all latest versions of Fedora, CentOS, Red Hat and OpenSUSE releases.
Controlling Virtual Machines	VirtualBox Main API On Windows platforms, the VirtualBox Main API uses Microsoft COM, a native COM implementation. On all other platforms, Mozilla XPCOM, an open-source COM implementation, is used.
Programming Languages support for application development	Java, C++, .NET, PHP, Python, Perl

IV. CONCLUSION:

There are numbers of Virtualization Tools (VMMs) that have been developed to manage virtual machines. Here we compare two most use full VMMs used in world called VMware workstation and VirtualBox with extra ordinary virtual machine management. For application development in cloud computing for managing VM the developer must choose VMM which has easy implementation. The current technology .NET which provides the web services and programming language support for application developers. The SDK of VMware has a programmable interface which is rich enough that enable developers to manage virtual machines. The VMWareLib from Vestris Inc. is provides the libraries for free to use with C#, Visual Basic, and Visual C++. Which is easier to understand and implement then the APIs given by the VirtualBox.

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