Academic Year: 2021-2022 **Semester: VIII**
Subject: Cloud Computing Lab **Class / Branch / Division: BE/CMPN A**
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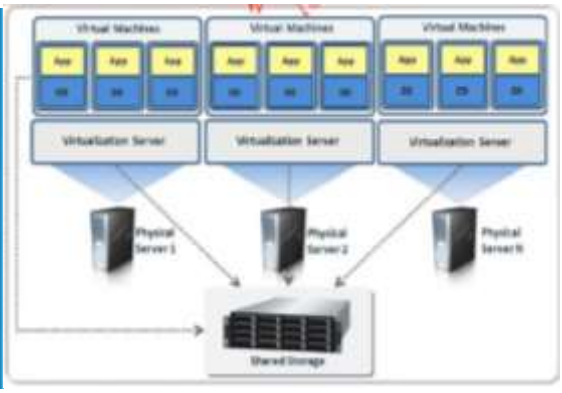
Experiment No:1

Aim: Installation of Operating System on Virtual Machine

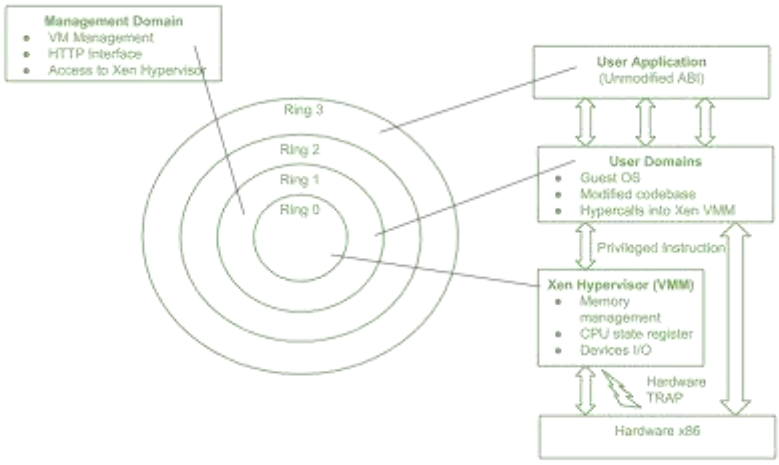
Theory:

1. **Introduction to Virtualization**
   - Virtualization is the "creation of a virtual (rather than actual) version of something, such as a server, a desktop, a storage, devices, and operating system or network"
   - Virtualization plays important role in Cloud computing, as it provides virtual storage and recourses and services to the cloud clients which is only possible through virtualization.
   - Virtualization is a technique that allows sharing of a single physical instance of a resource or an application among multiple customers and organizations. It does this by assigning a logical name to physical storage and providing a pointer to that physical resource when demanded.



2. **Different technologies used for virtualization**

XEN Virtualization: Xen is an open-source hypervisor based on paravirtualization. It is the most popular application of paravirtualization. Xen has been extended to be compatible with full virtualization using hardware-assisted virtualization. It enables high performance to execute the guest operating system. This is probably done by removing the performance loss while executing the instructions requiring significant handling and by modifying a portion of the guest operating system executed by Xen, concerning the execution of such instructions. Hence this especially supports x86, which is the most used architecture on commodity machines and servers.



VM ware Virtualization:

Server virtualization with VMware uses software to simulate the hardware and create a virtual computer system. Virtualization allows businesses to run multiple operating systems and applications on a single physical

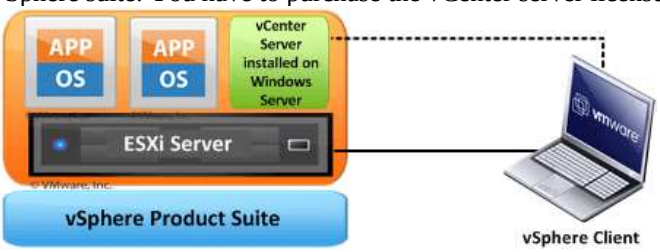
device. Within IT infrastructures, virtual computer systems are known as “virtual machines”. Virtual machines (VM) are isolated software containers with an operating system and application inside.

Each self-contained VM works independently. Putting multiple VMs on a single device enables several operating systems and applications to run on just one physical server. A thin layer of software called a hypervisor decouples virtual machines from the host and dynamically allocates resources to each virtual machine as needed.

Server virtualization provides economies of scale and increased efficiency. By using server virtualization, companies maximize their server resources and reduce the amount of hardware required for their operations. This results in server consolidation which improves efficiency and reduces costs.

3. Difference between vSphere, ESXi, and V center

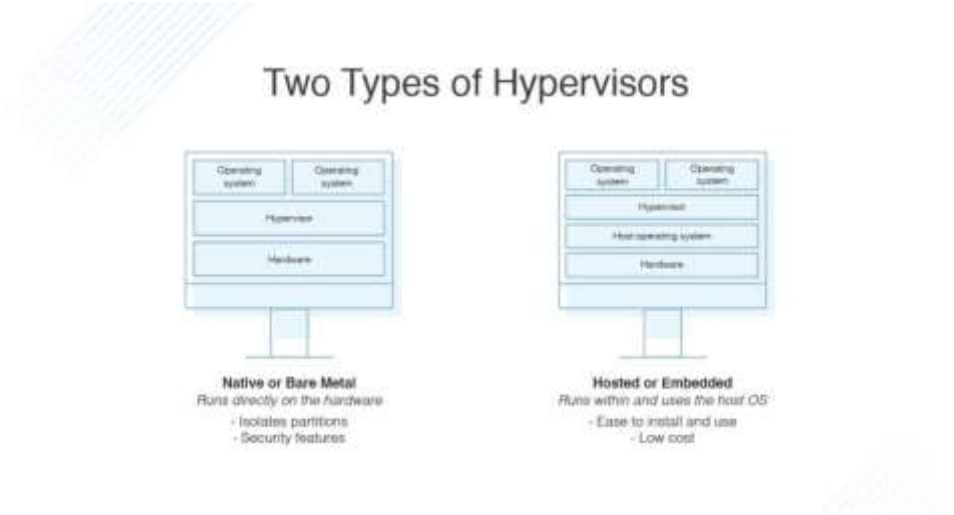
- VMware Inc. is a software company that develops many suites of software products especially for providing various virtualization solutions. There are many cloud products, data center products, desktop products, and so on.
- vSphere is a software suite that comes under data center product. vSphere is like Microsoft Office suite, which has much software like MS Office, MS Excel, MS Access, etc. Like Microsoft Office, vSphere is also a software suite that has many software components like vCenter, ESXi, vSphere client, and so on. So, the combination of all these software components is vSphere. vSphere is not a particular software that you can install and use, “it is just a package name which has other subcomponents”.
- ESXi, vSphere Client, and vCenter are components of VMware vSphere. ESXi server is the most important part of vSphere. ESXi is the virtualization server. It is a type 1 hypervisor. All the virtual machines or Guest OS are installed on the ESXi server. To install, manage and access those virtual servers which sit above of ESXi server, you will need another part of the vSphere suite called the vSphere client. Now, the vSphere client allows administrators to connect to ESXi servers and access or manage virtual machines. vSphere client is HTML5/web-based management portal. The Administrator logs into Web Browser to access the vSphere client to manage ESXi servers. vSphere Client for Windows or C# vSphere client is no longer available and is replaced by HTML5 based vSphere client in vSphere 6.7 eliminating the need for installing vSphere Client software to access the ESXi host. So now what is vCenter? Why do we need it? Try cloning an existing virtual machine using just a vSphere client without a vCenter server.
- vCenter server is another piece of the vSphere suite. There are two flavors of vCenter servers. vCenter Server can be installed on Windows Server or can be a Linux-based virtual appliance. VMware will discontinue the Windows-based vCenter server and release only Linux-based vCenter appliances in the future. VMware vCenter server is a centralized management application that lets you manage virtual machines and ESXi hosts centrally. vSphere client again is used to accessing vCenter Server and ultimately manage ESXi servers. vCenter server is compulsory for enterprises that need enterprise features like vMotion, VMware High Availability, VMware Update Manager, VMware Distributed Resource Scheduler (DRS), etc. For example, you can easily clone an existing virtual machine in the vCenter Server. So vCenter is another important part of the vSphere suite. You have to purchase the vCenter server license separately.



The diagram above shows the vSphere suite more descriptively. vSphere is a product suite, ESXi is a hypervisor installed on a physical machine. vSphere Client HTML5 is used to access ESXi Server to create and manage virtual machines on the ESXi server. vCenter Server is installed as a virtual machine on top of the ESXi server, it can also be Linux based virtual machine (or virtual appliance). vCenter server can also be installed on different standalone physical servers, but why not virtualize it too right? vCenter server is a vSphere component that is mostly used in a large environment where there are many ESXi hosts and virtual machines and require advanced enterprise features of vSphere. The vCenter server is also accessed by the vSphere client for management purposes. So, the vSphere client is used to accessing the ESXi server directly in a small environment. In a larger environment, the vSphere client is used again to access the vCenter server to manage the ESXi server.
You can install vSphere on your PC to get more knowledge of this amazing technology. For more information about VMware, you can visit VMware’s Official website.

4. Explain Hypervisor in detail (Host and Bare Metal Hypervisor)

A hypervisor is a form of virtualization software used in Cloud hosting to divide and allocate the resources on various pieces of hardware. The program which provides partitioning, isolation, or abstraction is called a virtualization hypervisor. The hypervisor is a hardware virtualization technique that allows multiple guest operating systems (OS) to run on a single host system at the same time. A hypervisor is sometimes also called a virtual machine manager(VMM).



TYPE-1 Hypervisor:
The hypervisor runs directly on the underlying host system. It is also known as a "Native Hypervisor" or "Bare metal hypervisor". It does not require any base server operating system. It has direct access to hardware resources. Examples of Type 1 hypervisors include VMware ESXi, Citrix XenServer, and Microsoft Hyper-V hypervisor.

Pros & Cons of Type-1 Hypervisor:
Pros: Such kinds of hypervisors are very efficient because they have direct access to the physical hardware resources(like Cpu, Memory, Network, Physical storage). This causes the empowerment of the security because there is nothing any kind of third-party resource so that attacker couldn't compromise with anything.
Cons: One problem with Type-1 hypervisors is that they usually need a dedicated separate machine to perform their operation and instruct different VMs and control the host hardware resources.

TYPE-2 Hypervisor:
A Host operating system runs on the underlying host system. It is also known as 'Hosted Hypervisor". Such kind of hypervisors doesn't run directly over the underlying hardware rather they run as an application in a Host system(physical machine). Software installed on an operating system. Hypervisor asks the operating system to make hardware calls. An example of a Type 2 hypervisor includes VMware Player or Parallels Desktop. Hosted hypervisors are often found on endpoints like PCs. The type-2 hypervisor is are very useful for engineers, security analysts (for checking malware, malicious source code, and newly developed applications).
Pros & Cons of Type-2 Hypervisor:
Pros: Such kind of hypervisors allows quick and easy access to a guest Operating System alongside the host machine running. These hypervisors usually come with additional useful features for guest machines. Such tools enhance the coordination between the host machine and the guest machine.
Cons: Here there is no direct access to the physical hardware resources so the efficiency of these hypervisors lags in performance as compared to the type-1 hypervisors, and potential security risks are also there an attacker can compromise the security weakness if there is access to the host operating system so he can also access the guest operating system.

5. Explain XEN, ESXi, and VMware.

- **XEN**

  Xen is the open-source hypervisor included in the Linux kernel and, as such, it is available in all Linus distributions. The Xen Project is one of the many open-source projects managed by the Linux Foundation. A typical environment running Xen consists of different parts. To start with, there's Domain 0. In Xen, this is how you refer to the host operating system
  (OS), as it's ready a bost OS in the sense that other viral machines (VMS)-domains in Xem tendency-don't have to use it to get access to the host server hardware. The domain is only responsible for access to the drivers, and if any coordination has to be done, it will be handled by Domain. Apart from Domain 0, then are the other VMs that are referred to as Domain U. Although Xen is included in the Linux kernel. only a few Linux distributions, such as Oracle Unbrinhle Line and SUSE Linn Enterprise Server, offer a supported Nen stack. Rod Hat included Xem up to Red Hat Enterprise Linux (RHEL) 5. but switched to a KVM-wide shut circle of L6

- **ESXI**

  VMware ESXi relies on the VMkernel, which is a microkernel, to run the hardware, guest systems, and service layer making up the VMware virtualization platform. The VMkernel runs the physical hardware and guest VMs,

connects directly to the CPU and memory, and uses modules linked via another module to access the hardware's networking and storage components.

Notable features of VMware ESXi include:

Small size

At just 150 MB, Vmware touts ESXi as the world's smallest hypervisor. A small footprint often means a reduced attack surface from outside threats, aside from easier maintainability. This also means that ESXi does not need frequent patching up.

Convenient installation

With its small size, faster installation is possible, allowing you to set up your infrastructure at the soonest time possible. You can even boot up ESXi from a USB flash drive.

User-friendly administration tools

ESXi offers a built-in, HTML5-compliant browser for administrative use. Organizations that require automated operations can also utilize the vSphere Command-Line Interface for remote management and application programming interfaces (APIs) based on Representational state transfer (REST).

Secure design

The data that exists in your VMs are secure from prying eyes using built-in encryption. Add role-based access plus extensive logging and auditing capabilities and you get a secure virtual platform at the outset.

Scalable reliability

No matter your application requirements, a single ESXi hypervisor can be configured to run as many as 128 virtual CPUs and 120 devices on 6 TB of memory. ESXi also features a high-performance cluster file system dubbed the Virtual Machine File System (VMFS) that allows more storage resources to be distributed, even with limited physical storage. VMs can also use more than one CPU simultaneously.

Extensive support and compatibility

ESXi's popularity as an enterprise platform means wide support from hardware vendors and application partners, as well as compatibility with a broad range of applications and guest operating systems.

- **VMware**

VMware is a virtualization and cloud computing software provider based in Palo Alto, Calif. Founded in 1998, VMware is a subsidiary of Dell Technologies. EMC Corporation originally acquired VMware in 2004; EMC was later acquired by Dell Technologies in 2016. VMware bases its virtualization technologies on its bare-metal hypervisor ESX/ESXi in x86 architecture.
With VMware server virtualization, a hypervisor is installed on the physical server to allow for multiple virtual machines (VMs) to run on the same physical server. Each VM can run its operating system (OS), which means multiple OSes can run on one physical server. All the VMs on the same physical server share resources, such as networking and RAM. In 2019, VMware added support to its hypervisor to run containerized workloads in a Kubernetes cluster in a similar way. These types of workloads can be managed by the infrastructure team in the same way as virtual machines and the DevOps teams can deploy containers as they were used to.

6. Advantages and limitations of virtualization

Benefits of Virtualization:

Features	Benefits
Flexible data transfer	The data transferring process becomes easier with virtualization as it supports data transfer with no limit scenario. This data can be easily retrieved whenever required.
Ease in data retrieval	Retrieving the data by using the cloud becomes easier with virtualization.
Economical	It is more economical as it needs not any extra cost. It reduces the extra cost that will incur for buying hardware and software

Eliminates the risk of getting failure	During working on a normal system, pc might crash out. Data can't be retrieved. But in the cloud, it is safer and easier to retrieve.
Reduce workload	The third-party provider makes the installation of Hardware and software
Overhead cost reduction	Datacenter, hardware, maintenance cost is reduced.
Multisharing	Cloud gives the privilege of multi-sharing.

Shortcomings of virtualization:

Features	Description
Availability	Every time it is not necessary, that connection is maintained. Due to some technical faults, the chances server may not be available. That can create issues.
Scalability issues	Devices are unable to extend sometimes.
Implementation cost	Implementation cost exceeds the limit in some cases that making it not good to use.
Security issues	As data is over the cloud if you are using the public cloud. Chances are more than your data can come under security threat. Sometimes using a private cloud is not viable.

Use of Virtualisation in Industries:

1. Manufacturing: Virtualisation plays a vital role in the manufacturing industry as it is responsible for providing global supply chains and improving the utilization of IT resources.
2. Healthcare: Electronic health care records are categorized here. By using those doctors easily update the patient details. Also, they can make use of it whenever they want.
3. Education: These days many schools are working on clouds, to improve better lab facilities.

Conclusion:

In this experiment we have completed installing operating system on virtual machine vm box.