
2. Virtualization

2.1 Introduction, Characteristics of virtualized environment:

- (a) Define Virtualization. State its Benefits.
- (b) Explain Characteristics of Virtualized environment. (c) What is Hypervisor ? State their types.

Introduction of Virtualization:

- Virtualization is a large umbrella of technologies and concepts that are meant to provide an abstract environment—whether virtual hardware or an operating system—to run applications.
- The term virtualization is often synonymous with hardware virtualization, which plays a fundamental role in efficiently delivering Infrastructure-as-a-Service (IaaS) solutions for cloud computing.
- In fact, virtualization technologies have a long trail in the history of computer science and have been available in many flavors by providing virtual environments at the operating system level, the programming language level, and the application level.
- Moreover, virtualization technologies provide a virtual environment for not only executing applications but also for storage, memory, and networking.
- Virtualization is a process that allows for more efficient utilization of physical computer hardware and is the foundation of cloud computing.
- It follows that virtualization enables more efficient utilization of physical computer hardware and allows a greater return on an organization's hardware investment.
- Today, virtualization is a standard practice in enterprise IT architecture. It is also the technology that drives [cloud computing](#) economics.
- Virtualization enables cloud providers to serve users with their existing physical computer hardware; it enables cloud users to purchase only the computing resources they need when they need it, and to scale those resources cost-effectively as their workloads grow.

Definition of Virtualization:

- A technology that you can use to create virtual representations of servers, storage, networks, and other physical machines is called Virtualization. Virtual software mimics the functions of physical hardware to run multiple virtual machines simultaneously on a single physical machine.
- Virtualization uses software to create an abstraction layer over computer hardware that allows the hardware elements of a single computer—processors, memory, storage and more—to be divided into multiple virtual computers, commonly called virtual machines (VMs). Each VM runs its own operating system (OS) and behaves like an independent computer, even though it is running on just a portion of the actual underlying computer hardware.
- Virtualization is a technique which allows to share a single physical instance of an application or resource among multiple organizations or tenants(customers) It does so by assigning a logical name to a physical resource and providing a pointer to that physical resource on demand.

Benefits/ Gain of Virtualization:

- Increased performance and computing capacity.
- Underutilized hardware and software resources. • Lack of space.
- Greening initiatives.
- Rise of administrative costs.

Characteristics of virtualized environments:

- Virtualization is a broad concept that refers to the creation of a virtual version of something, whether hardware, a software environment, storage, or a network. In a virtualized environment there are three major components: guest, host, and virtualization layer.

-The guest represents the system component that interacts with the virtualization layer rather than with the host, as would normally happen. The host represents the original environment where the guest is supposed to be managed. The virtualization layer is responsible for recreating the same or a different environment where the guest will operate.

Figure illustrate characteristics of virtualization environments:

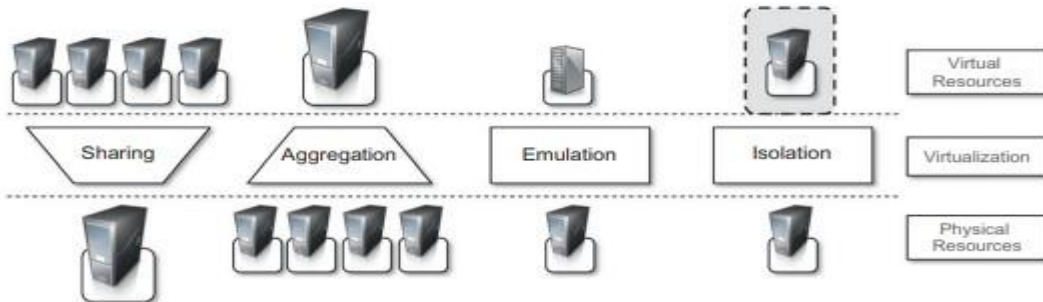


Figure: characteristics of virtualization environments:

1. Increased security:

- The ability to control the execution of a guest in a completely transparent manner opens new possibilities for delivering a secure, controlled execution environment.
- The virtual machine represents an emulated environment in which the guest is executed. All the operations of the guest are generally performed against the virtual machine, which then translates and applies them to the host.

2. Managed execution:

- Virtualization of the execution environment not only allows increased security, but a wider range of features also can be implemented.

3. Sharing:

- Virtualization allows the creation of a separate computing environments within the same host. In this way it is possible to fully exploit the capabilities of a powerful guest, which would otherwise be underutilized.
- As we will see in later chapters, sharing is a particularly important feature in virtualized data centers, where this basic feature is used to reduce the number of active servers and limit power consumption.

4. Aggregation:

- Not only is it possible to share physical resource among several guests, but virtualization also allows aggregation, which is the opposite process. A group of separate hosts can be tied together and represented to guests as a single virtual host.
- This function is naturally implemented in middleware for distributed computing, with a classical example represented by cluster management software, which harnesses the physical resources of a homogeneous group of machines and represents them as a single resource.

5. Emulation:

- Guest programs are executed within an environment that is controlled by the virtualization layer, which ultimately is a program. This allows for controlling and tuning the environment that is exposed to guests.
- For instance, a completely different environment with respect to the host can be emulated, thus allowing the execution of guest programs requiring specific characteristics that are not present in the physical host.

6. Isolation:

- Virtualization allows providing guests—whether they are operating systems, applications, or other entities—with a completely separate environment, in which they are executed. The guest program performs its activity by interacting with an abstraction layer, which provides access to the underlying resources.
- Isolation brings several benefits; for example, First, it allows multiple guests to run on the same host without interfering with each other. Second, it provides a separation between the host and the guest. The virtual machine can filter the activity of the guest and prevent harmful operations against the host.

7. Portability :

- The concept of portability applies in different ways according to the specific type of virtualization considered.
- In the case of a hardware virtualization solution, the guest is packaged into a virtual image that, in most cases, can be safely moved and executed on top of different virtual machines.
- Except for the file size, this happens with the same simplicity with which we can display a picture image in different computers.

Hypervisor and Its types:

1. Hypervisor :

- Hypervisor is a firmware or a low level program which is a key to enable virtualization. It is used to divide and allocate cloud resources between several customers.
- As it monitors and manages cloud services/resources that's why hypervisor is called as VMM (Virtual Machine Monitor) or (Virtual Machine Manager).

2. Types of Hypervisor are:

1. Type1 hypervisor:

- Type I hypervisors run directly on top of the hardware. Therefore, they take the place of the operating systems and interact directly with the ISA interface exposed by the underlying hardware, and they emulate this interface in order to allow the management of guest operating systems.
- This type of hypervisor is also called a native virtual machine since it runs natively on hardware.
- It executes on bare system. It does not have any host Operating system because they are installed on bare system.
- Ex: Lynx Secure, RTS Hypervisor, Oracle VM, Sunx VM 2.
- Figure -

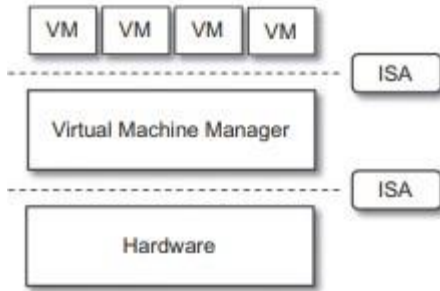


Figure: Type1 Hypervisor

2. Type2 Hypervisor:

- Type II hypervisors require the support of an operating system to provide virtualization services. This means that they are programs managed by the operating system, which interact with it through the ABI and emulate the ISA of virtual hardware for guest operating systems.
- This type of hypervisor is also called a hosted virtual machine since it is hosted within an operating system.
- It is a software interface that emulates the device with which a system normally interacts.
- It Contains, KVM, Microsoft HyperV, VMWare fusion, Virtual Server 2005 R2, windows Virtual PC and VMWare Workstation 60.
- Figure-

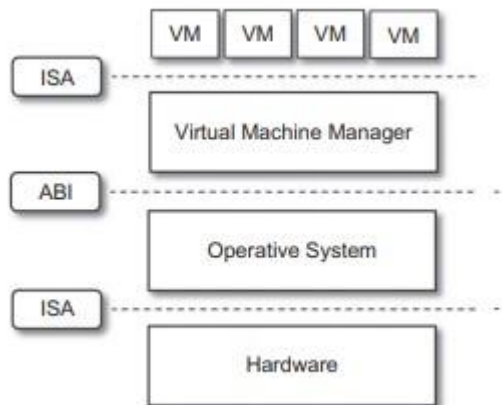


Figure: Type2 Hypervisor