

UNIT 2

UNIT - 2

ABSTRACTION AND VIRTUALIZATION

<http://www.differencebetween.net/technology/difference-between-abstraction-and-virtualization/>

<https://www.codingninjas.com/codestudio/library/abstraction-and-virtualization>

<http://poposir.orgfree.com/cld2.php?id=191&fname=c2.1.1.ppsx>

(1) INTRODUCTION

Virtualization separates IT resources and services from the underlying physical delivery environment. Abstraction is the technical term for this act of separation, and virtualization assists in making your IT infrastructure intelligent enough to handle large data analysis.

(2) ABSTRACTION

- ✚ Abstraction is the practice of concealing an application's internal details from the outside world.
- ✚ Things are described in simple terms using abstraction.
- ✚ It serves as a barrier between the application and the client programs.
- ✚ There are two types of abstraction: data abstraction and process/control abstraction. Data abstraction conceals data specifics, while control/process conceals implementation details.
- ✚ An object-oriented approach can abstract both data and functions.
- ✚ In OOP, however, classes are typically created so that data is concealed from the outside world, and functions serve as the public interface.
- ✚ That is, functions outside the class can directly access the class's functions, and these functions can indirectly access the class's concealed data.
- ✚ In computer science and software development, abstraction is a fundamental notion.
- ✚ The abstraction process is also known as modeling, and it is strongly linked to the notions of theory and design.
- ✚ Models can also be thought of as abstractions because they generalize reality features.

(3) VIRTUALIZATION

- ✚ Virtualization is one of the fundamental components of cloud computing that allows creating a virtual version (rather than actual) of something, including computer resources, virtual computer hardware platform, operating system, and storage devices.
- ✚ Virtualization employs software to construct an abstraction layer over computer hardware that allows a single computer's physical elements—processors, memory, storage, and other components—to be separated into several virtual computers, also known as virtual machines (VMs).
- ✚ Even though it is just running on the part of the actual underlying computer hardware, Each virtual machine (VM) has its operating system (OS) and operates independently.
- ✚ Virtualization is the core of cloud computing since it allows for more efficient use of actual computer hardware. It allows an organization to get a better return on its hardware investment.
- ✚ Virtualization is now considered commonplace in enterprise IT design.
- ✚ Cloud computing economics are also driven by technology.
- ✚ Cloud providers can service users using their current physical computer gear, and cloud users can buy only the computing resources they need as their workloads develop.

BASIS OF COMPARISON	ABSTRACTION	VIRTUALIZATION
Description	It is the act of representing essential features while hiding the background details from users and developers.	It is an aggregate of technologies and concepts that are intended to provide an abstract environment to run applications.
Use	It allows abstraction of the physical implementation to hide technical details from consumers.	It allows creating a virtual version of something, including computer resources, virtual computer hardware platform and storage devices.
Importance	It allows changes to be occurred in the backend without affecting functionalities of the applications in the abstraction layer.	Computer resources can be divided or shaped by multiple environments simultaneously, which are known as virtual machines.
Reliance	Abstraction relies on the separation of interface and implementation.	Virtualization relies on software to simulate hardware functionality and create a virtual computer system.
Types	There are two types of Abstraction: Data Abstraction and Process Abstraction.	Types of virtualization include: Network virtualization, Storage virtualization, data virtualization, desktop virtualization, application virtualization and server virtualization.

(3.1) TYPES OF VIRTUALIZATION

<https://www.techtarget.com/searchvmware/definition/VMware-vSphere>

<https://www.liquidweb.com/kb/what-is-vmware-vsphere/>

There are three distinct types of virtualization: server virtualization, network virtualization, and desktop virtualization.

Server Virtualization

Server virtualization is the process of creating multiple unique instances of a server on one physical machine. You essentially divide that host machine into several isolated virtual servers.

This form of virtualization overcomes the restriction of servers running a single workload. With server virtualization, you can configure each virtual server's hardware specifications and operating systems to perform different workloads, improving efficiency while saving costs.

Network Virtualization

Network virtualization is divided into internal and external classes. Internal network virtualization allows for the recreation of physical network infrastructure in a virtual environment, enabling communication between virtual and host machines.

External network virtualization involves combining two or more physically connected networks into one virtual networking unit. Both types of network virtualization improve centralizing your infrastructure and flexibly allocate resources according to workload demands.

Desktop Virtualization

Desktop virtualization simulates a workstation environment that end users can access without having the hardware to run that environment in front of them. IT departments can use it to grant remote users access to their work desktops, complete with their office applications and documents.

A virtualization server hosts the virtual desktop environment, and all the user needs to access it is a display, keyboard, mouse, and a network connection.

Ques : Which type of Virtualization is also characteristic of cloud computing?

Storage, Application, and CPU are also characteristic of cloud computing.

Ques : Which software can be used to implement load balancing?

Load balancing can increase utilization and throughput, lower latency, reduce response time, and avoid system overload.

Ques : What type of computing technology refers to services and applications that run on a distributed network through virtualized resources?

Cloud computing is a computing technique in which common internet protocols and networking standards access applications.

Ques : Which are many features that are now known as cloud computing?

The Internet provides the abstraction, runs through the same set of protocols and standards, and uses the same operating system and applications.

Ques : Which is an essential concept related to the Cloud?

Cloud computing hides all the detail of system implementation from users and developers.

(4) CLOUD MOBILITY

Cloud mobility is related to balancing the resources and the costs between different cloud services which can be public or private cloud services. It is an emerging trend aimed at making workload migration across the platform easier. Mobility helps to accomplish the jobs and customer requirements in a cloud environment.

P2V: Physical to Virtual

V2V: Virtual to Virtual

V2P: Virtual to Physical

P2P: Physical to Physical

D2C: Data center to Cloud

C2C: Cloud to Cloud

C2D: Cloud to Data center

D2D: Data center to Data center

Physical To Virtual (P2V)

<https://www.techopedia.com/definition/16815/physical-to-virtual-p2v>

- ✚ Physical to virtual (P2V) is the process of converting and migrating a physical computer image into a virtual machine (VM).
- ✚ It allows a physical machine to transform into a VM with the same state, stored data, applications and required system configuration and resources.

- In a P2V migration, the operating system running on a physical system is copied to a virtual machine.
- Physical to virtual is also known as physical to virtual migration (P2V migration).

Virtual To Virtual (V2V)

<https://www.techopedia.com/definition/16819/virtual-to-virtual-v2v>

- Virtual to virtual (V2V) is a process of copying, migrating or replicating a virtual machine (VM) image, data or disk partition to another VM.
- It facilitates the migration of data or a machine instance between VMs and/or virtualization environments.
- In a V2V migration, an existing virtual machine running on one virtualization platform is copied to a virtual machine running on another virtualization platform.

Virtual To Physical (V2P)

<https://www.techopedia.com/definition/16818/virtual-to-physical-v2p>

- Virtual to physical (V2P) is the process of converting or porting a virtual machine (VM) onto and/or as a standard physical machine.
- V2P allows a VM to transform into a physical machine without losing its state, data and overall operations.
- Virtual to physical is also known as virtual to physical migration (V2P migration).

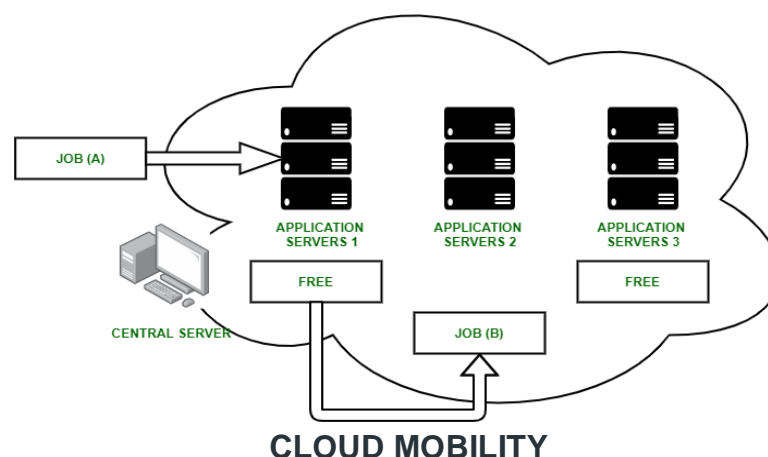
Types of Cloud Mobility :

1. Weak Mobility –

- It permits the code to migrate through the networks.
- In some cases, the code has initial data assigned but without execution states.
- In weak mobility, the codes migrate without their execution states.

2. Strong Mobility –

- It grants the code and execution state to start again at a new resource.
- This can save running time, processor, registers and program counters.



(5) LOAD BALANCING AND VIRTUALIZATION

- ✚ One characteristic of cloud computing is virtualized network access to a service. No matter where you access the service, you are directed to the available resources.
- ✚ Load balancing is the method that allows you to have a proper balance of the amount of work being done on different pieces of device or hardware equipment. Typically, what happens is that the load of the devices is balanced between different servers or between the CPU and hard drives in a single cloud server.
- ✚ Cloud load balancing is defined as dividing workload and computing properties in cloud computing.
- ✚ Load balancing is an optimization technique; it can be used to increase utilization and throughput, lower latency, reduce response time, and avoid system overload.
- ✚ The technology used to distribute service requests to resources is referred to as load balancing.
- ✚ *Load balancing can be implemented in hardware, as is the case with F5's BigIP servers, or in software, such as the Apache mod_proxy_balancer extension, the Pound load balancer and reverse proxy software, and the Squid proxy and cache daemon.*

Different Types of Load Balancing Algorithms in Cloud Computing:

1. Static Algorithm
2. Dynamic Algorithm
3. Round Robin Algorithm
4. Weighted Round Robin Load Balancing Algorithm
5. Opportunistic Load Balancing Algorithm
6. Minimum To Minimum Load Balancing Algorithm

Examples of Load Balancers -

- ✚ Direct Routing Request Despatch Technique
- ✚ Dispatcher-Based Load Balancing Cluster
- ✚ Linux Virtual Load Balancer

(6) WHAT IS AN APPLICATION DELIVERY CONTROLLER

- ✚ ADC represents the Application delivery controller. It handles and directs the data flow among client connections and Web or enterprise software and can be used in the design of hardware devices or application programs.
- ✚ ADCs are generally related to application delivery networks (AND) where their goal is to implement simple tasks like what Web sites generally do to lessen the load from the Web servers.
- ✚ ADCs can also be discovered between a firewall and various software servers in a Web farm within a demilitarized zone (DMZ).

(7) WHAT IS AN APPLICATION DELIVERY NETWORK

- ✚ An Application Delivery Network (AND) is a group of services deployed simultaneously over a network to provide application availability, security, visibility and acceleration from application servers to application end users.
- ✚ Application delivery networking is comprised of WAN optimization controllers (WOCs) and application delivery controllers (ADCs).

- + An application delivery network (AND) ensures the speediness, security and availability of applications.
- + The AND delivers a suite of technologies over a network designed to maximize application performance.
- + Load balancing is often included. An AND is sometimes referred to as a content delivery network (CDN).

(8) THE GOOGLE CLOUD

- + Google Cloud consists of a set of physical assets, such as computers and hard disk drives, and virtual resources, such as virtual machines (VMs), that are contained in Google's data centers around the globe. Each data center location is in a region.
- + Google Cloud offers services for compute, storage, networking, big data, machine learning and IoT, as well as cloud management, security and developer tools.
- + Google is the single most heavily visited site on the Internet; that is, Google gets the most hits.
- + The investment Google has made in infrastructure is enormous, and the Google cloud is one of the largest in use today.
- + It is estimated that Google runs over a million servers worldwide, processes a billion search requests, and generates twenty petabytes of data per day.

(9) UNDERSTANDING HYPERVISORS

- + A hypervisor is a form of virtualization software used in Cloud hosting to divide and allocate the resources on various pieces of hardware.
- + A hypervisor is a type of computer software, firmware or hardware that creates and runs virtual machines. A computer on which a hypervisor runs one or more virtual machines is called a host machine, and each virtual machine is called a guest machine.
- + 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 software that creates and runs virtual machines (VMs). A hypervisor allows one host computer to support multiple guest VMs by virtually sharing its resources, such as memory and processing.
- + A hypervisor, sometimes called a **virtual machine monitor (VMM)**, isolates the hypervisor operating system and resources from the virtual machines and enables the creation and management of those VMs.
- + Load balancing virtualizes systems and resources by mapping a logical address to a physical address.
- + Another fundamental technology for abstraction creates virtual systems out of physical systems.

Types of hypervisors

(a) Type 1 hypervisor acts like a lightweight operating system and runs directly on the host's hardware.

(b) Type 2 hypervisor runs as a software layer on an operating system, like other computer programs.

(a) 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, and Physical storage).
- ✚ This causes the empowerment of the security because there is nothing any kind of the 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 to instruct different VMs and control the host hardware resources.

(b) 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).
- ✚ Basically, the software is 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 very useful for engineers, and security analysts (for checking malware, or 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 as 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.

Choosing the right hypervisor :

Type 1 hypervisors offer much better performance than Type 2 ones because there's no middle layer, making them the logical choice for mission-critical applications and workloads. But that's not to say that hosted hypervisors don't have their place – they're much simpler to set up, so they're a good bet if, say, you need to deploy a test environment quickly. One of the best ways to determine which hypervisor meets your needs is to compare

their performance metrics. These include CPU overhead, the amount of maximum host and guest memory, and support for virtual processors.

The following factors should be examined before choosing a suitable hypervisor:

1. Understand your needs: The company and its applications are the reason for the data center (and your job). Besides your company's needs, you (and your co-workers in IT) also have your own needs.

Needs for a virtualization hypervisor are:

- | | | | |
|----------------|----------------|---------------------|-----------------|
| a. Flexibility | b. Scalability | c. Usability | d. Availability |
| e. Reliability | f. Efficiency | g. Reliable support | |

2. The cost of a hypervisor: For many buyers, the toughest part of choosing a hypervisor is striking the right balance between cost and functionality. While a number of entry-level solutions are free, or practically free, the prices at the opposite end of the market can be staggering. Licensing frameworks also vary, so it's important to be aware of exactly what you're getting for your money.

3. Virtual machine performance: Virtual systems should meet or exceed the performance of their physical counterparts, at least in relation to the applications within each server. Everything beyond meeting this benchmark is profit.

4. Ecosystem: It's tempting to overlook the role of a hypervisor's ecosystem – that is, the availability of documentation, support, training, third-party developers and consultancies, and so on – in determining whether or not a solution is cost-effective in the long term.

HYPERVISOR REFERENCE MODEL :

There are 3 main modules coordinates in order to emulate the underlying hardware:

1. **DISPATCHER:** The dispatcher behaves like the entry point of the monitor and reroutes the instructions of the virtual machine instance to one of the other two modules.
2. **ALLOCATOR:** The allocator is responsible for deciding the system resources to be provided to the virtual machine instance. It means whenever a virtual machine tries to execute an instruction that results in changing the machine resources associated with the virtual machine, the allocator is invoked by the dispatcher.
3. **INTERPRETER:** The interpreter module consists of interpreter routines. These are executed, whenever a virtual machine executes a privileged instruction

(10) VMWARE VSPHERE

<https://www.techtarget.com/searchvmware/definition/VMware-vSphere>

<https://www.liquidweb.com/kb/what-is-vmware-vsphere/>

- + VMware vSphere formerly known as VMware Infrastructure -- is the brand name for VMware's suite of server virtualization products that includes its ESXi hypervisor and vCenter management software.
- + VSphere undergoes periodic revisions and updates to add features, modifications to the application program interface (API) and changes to the ESXi Shell.
- + vSphere has two core components: ESXi and vCenter Server.

- ✚ The vCenter Server component handles the management duties in vSphere. vCenter Server provides a centralized platform for managing the host and virtual machines in the vSphere environment.
- ✚ VSphere is just one of these VMware virtual solutions, and it is an advanced server virtualization application that grants users a centralized management platform for their virtual machines (VMs).

There are two main versions of vSphere:

- ✚ The VMware vSphere Standard is perfect for small businesses looking to get started with centralized VM management.
- ✚ The vSphere Enterprise Plus Edition has features for migrating existing data centers into cloud computing environments.

VMware vSphere features

- ✚ Support for Kubernetes Containers
- ✚ Improves Resource Management with Distributed Resource Scheduler
- ✚ Centralized Lifecycle Management
- ✚ Enhanced Security
- ✚ Business Continuity

VMware vSphere includes the following components:

- ✚ VMware ESXi: a type 1 hypervisor responsible for abstracting processors, memory, storage and other resources into multiple virtual machines (VMs).
- ✚ VMware vCenter Server: formerly known as VirtualCenter, this management tool is the central control point for data center services and provides a single pane of glass view across ESXi hosts.
- ✚ VMware vSphere Client: a new HTML5-based management interface that enables users to remotely connect to vCenter Server. The vSphere Client will eventually replace the vSphere Web Client, but is not yet complete.
- ✚ VMware vSphere software development kits (SDKs): these provide interfaces through which users can access vSphere components.
- ✚ VMware Virtual Machine File System (VMFS): a high-performance cluster file system for ESXi VMs.

VMWARE	VIRTUAL BOX
VMware is virtualization software that helps you to run multiple operating systems in a single host.	VirtualBox is an Oracle tool to provide host-based virtualization.
It is a type 1 Hypervisor.	It is a type 2 Hypervisor.
Offers virtualization at the hardware level.	Offers virtualization at both hardware and software levels.

It can run on Linux, Windows, and macOS.	It can run on Linux, Windows, Solaris, and macOS.
It is not an open-source tool.	It is an open-source tool.
It offers limited Virtual Machine encryption.	It offers Virtual Machine encryption with the extension pack.
It does not offer any shared storage support.	It offers shared storage support with NFS, CIFS, and iSCSI.
Out-of-the-box USB device support is provided.	For the functionality of USB 2.0/3.0, Extension Pack is required.
Video memory is limited to 2 GB.	Video memory is limited to 128 MB.
3D acceleration is default enabled.	3D acceleration needs to be manually enabled.
It supports VMDK disk format.	It supports VDI, VHD, VMDK and HDD disk formats
It is used for enterprise and home purposes.	It is used for educational and private purposes.

S.No.	VMware	VirtualBox
1.	VMware is virtualization software that helps you to run multiple operating systems in a single host.	VirtualBox is an Oracle tool to provide host-based virtualization.
2.	It is used for enterprise and home purposes.	It is used for educational and private purposes.
3.	Offers virtualization at the hardware level.	Offers virtualization at both hardware and software levels.
4.	The proprietary license can be availed for \$79.99.	The proprietary license can be availed for \$79.99.
5.	It can run on Linux, Windows, and macOS.	It can run on Linux, Windows, Solaris, and macOS.
6.	It is not an open-source tool.	It is an open-source tool.
7.	It offers limited Virtual Machine encryption.	It offers Virtual Machine encryption with the extension pack.
8.	It supports VMDK disk format.	It supports VDI, VHD, VMDK and HDD disk formats
9.	It does not offer any shared storage support.	It offers shared storage support with NFS, CIFS, and iSCSI.
10.	VMware offers ease of access to the users.	VirtualBox does not allow ease of access as compared to VMware.
11.	It provides a complicated user interface.	It provides a user-friendly interface.
12.	Out-of-the-box USB device support is provided.	For the functionality of USB 2.0/3.0, Extension Pack is required.
13.	Video memory is limited to 2 GB.	Video memory is limited to 128 MB.
14.	3D acceleration is default enabled.	3D acceleration needs to be manually enabled.

Basis Of	IAAS	PAAS	SAAS
Stands for	Infrastructure as a service.	Platform as a service.	Software as a service.
Uses	IAAS is used by network architects.	PAAS is used by developers.	SAAS is used by the end user.
Access	IAAS gives access to the resources like virtual machines and virtual storage.	PAAS gives access to run time environment to deployment and development tools for application.	SAAS gives access to the end user.
Model	It is a service model that provides virtualized computing resources over the internet.	It is a cloud computing model that delivers tools that are used for the development of applications.	It is a service model in cloud computing that hosts software to make it available to clients.
Technical understanding.	It requires technical knowledge.	Some knowledge is required for the basic setup.	There is no requirement about technicalities company handles everything.
Popularity.	It is popular among developers and researchers.	It is popular among developers who focus on the development of apps and scripts.	It is popular among consumers and companies, such as file sharing, email, and networking.
Cloud services.	Amazon Web Services, sun, vCloud Express.	Facebook, and Google search engine.	MS Office web, Facebook and Google Apps.
Enterprise services.	AWS virtual private cloud.	Microsoft Azure.	IBM cloud analysis.
Outsourced cloud services.	Salesforce	Force.com, Gigaspaces.	AWS, Terremark
User Controls	Operating System, Runtime, Middleware, and Application data	Data of the application	Nothing

Advantages of IaaS

- ✚ The resources can be deployed by the provider to a customer's environment at any given time.
- ✚ Its ability to offer the users to scale the business based on their requirements.
- ✚ The provider has various options when deploying resources including virtual machines, applications, storage, and networks.
- ✚ It has the potential to handle an immense number of users.
- ✚ It is easy to expand and saves a lot of money. Companies can afford the huge costs associated with the implementation of advanced technologies.

Advantages of PaaS –

- ✚ Programmers need not worry about what specific database or language the application has been programmed in.
- ✚ It offers developers the to build applications without the overhead of the underlying operating system or infrastructure.
- ✚ Provides the freedom to developers to focus on the application's design while the platform takes care of the language and the database.

Advantages of SaaS

- ✚ It is a cloud computing service category providing a wide range of hosted capabilities and services. These can be used to build and deploy web-based software applications.
- ✚ It provides a lower cost of ownership than on-premises software. The reason is it does not require the purchase or installation of hardware or licenses.
- ✚ It can be easily accessed through a browser along a thin client.