

Cloud Computing -CH-2

Cloud Service Models

Topics

- Software as a Service (SaaS)
- SaaS Integration Services
- Advantages and Disadvantages
- Infrastructure As a Services (IaaS)
- Introduction to Virtual Machines
- VM Migration
- Advantages and Disadvantages
- Platform As a service (PaaS)
- Integration of Private and Public Cloud
- Advantages and Disadvantages

Cloud services / Business models

Cloud services are **infrastructure, platforms, or software** that are hosted by third-party providers and made available to users through the internet.

They are basically divided into 5 parts:

- Software as a service (SaaS)
- Platform as a service (PaaS)
- Infrastructure as a service (IaaS)
- Anything/Everything as a service (XaaS)
- Function as a Service (FaaS)



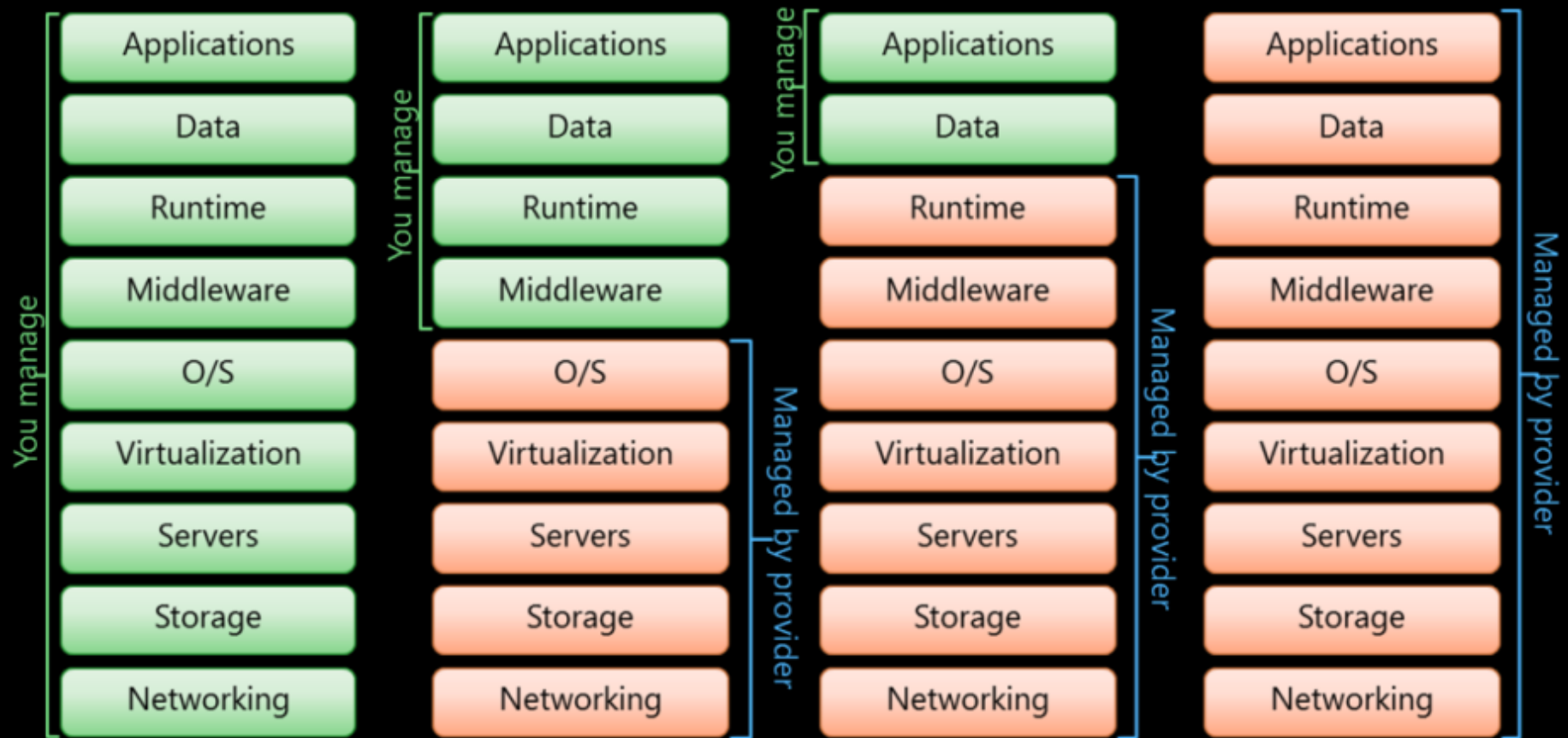
Infrastructure



Platform



Software



Software as a Service(SaaS)

Software-as-a-Service (SaaS) is a way of delivering **services and applications** over the Internet.

Instead of installing and maintaining software, we simply access it via the Internet, freeing ourselves from the complex software and hardware management.

It removes the need to install and run applications on our own computers or in the data centers **eliminating the expenses of hardware** as well as software maintenance.

Software as a Service(SaaS) .. II

SaaS provides a complete software solution that you purchase on a **pay-as-you-go** basis from a cloud service provider.

Most SaaS applications can be run directly from a web browser without any downloads or installations required.

The SaaS applications are sometimes called **Web-based software, on-demand software, or hosted software**

Advantages of SaaS

1. Cost-Effective: Pay only for what you use.
2. Reduced time: Users can run most SaaS apps directly from their web browser without needing to download and install any software.
3. Accessibility: We can Access app data from anywhere.
4. Automatic updates: Rather than purchasing new software, customers rely on a SaaS provider to automatically perform the updates.

Disadvantages of SaaS

1. **Limited customization**: SaaS solutions are typically not as customizable as on-premises software, meaning that users may have to work within the constraints of the SaaS provider's platform and may not be able to tailor the software to their specific needs.
2. **Dependence on internet connectivity**: SaaS solutions are typically cloud-based, which means that they require a stable internet connection to function properly.
3. **Security concerns**: SaaS providers are responsible for maintaining the security of the data stored on their servers, but there is still a risk of data breaches or other security incidents.
4. **Limited control over data**: SaaS providers may have access to a user's data, which can be a concern for organizations that need to maintain strict control over their data for regulatory or other reasons.

Platform as a Service

PaaS is a category of cloud computing that provides a platform and environment to allow developers to build applications and services over the internet.

PaaS services are hosted in the cloud and accessed by users simply via their web browser.

A PaaS provider hosts the hardware and software on its own infrastructure.

Platform as a Service (PAAS) ..II

PaaS makes users free from having to install in-house hardware and software to develop or run a new application. Thus, the **development and deployment** of the application take place **independent of the hardware**.

The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the **deployed applications** and possibly **configuration settings** for the application-hosting environment.

Advantages of PaaS

1. Simple and convenient for users: It provides much of the infrastructure and other IT services, which users can access anywhere via a web browser.
2. Cost-Effective: It charges for the services provided on a per-use basis thus eliminating the expenses one may have for on-premises hardware and software.
3. **Efficiently managing the lifecycle**: It is designed to support the complete web application lifecycle: building, testing, deploying, managing, and updating.
4. **Efficiency**: It allows for **higher-level programming** with **reduced complexity** thus, the overall development of the application can be more effective

Disadvantages of PaaS

1. Limited control over infrastructure: PaaS providers typically manage the underlying infrastructure and take care of maintenance and updates, but this can also mean that users have less control over the environment and may not be able to make certain customizations.
2. Dependence on the provider: Users are dependent on the PaaS provider for the availability, scalability, and reliability of the platform, which can be a risk if the provider experiences outages or other issues.
3. Limited flexibility: PaaS solutions may not be able to accommodate certain types of workloads or applications, which can limit the value of the solution for certain organizations.

Infrastructure as a Service (IAAS)

Infrastructure as a service (IaaS) is a service model that delivers **computer infrastructure** on an outsourced basis to support various operations.

Typically IaaS is a service where **infrastructure** is **provided as outsourcing** to enterprises such as networking equipment, devices, database, and web servers.

It is also known as **Hardware as a Service** (HaaS). IaaS customers pay on a per-user basis, typically by the hour, week, or month.

Some providers also charge customers based on the amount of virtual machine space they use.

Advantages of IaaS

1. **Cost-Effective:** Eliminates capital expense and reduces ongoing cost and IaaS customers pay on a per-user basis, typically by the hour, week, or month.
2. **Website hosting:** Running websites using IaaS can be less expensive than traditional web hosting.
3. **Security:** The IaaS Cloud Provider may provide better security than your existing software.
4. **Maintenance:** There is no need to manage the underlying data center or the introduction of new releases of the development or underlying software. This is all handled by the IaaS Cloud Provider.

Disadvantages of IaaS

1. Limited control over infrastructure: IaaS providers typically manage the underlying infrastructure and take care of maintenance and updates, but this can also mean that users have less control over the environment and may not be able to make certain customizations.
2. Security concerns: Users are responsible for securing their own data and applications, which can be a significant undertaking.
3. Limited access: Cloud computing may not be accessible in certain regions and countries due to legal policies.

Anything as a Service

It is also known as **Everything as a Service**. Most of the cloud service providers nowadays offer anything as a service that is a compilation of all of the above services including some additional services.

Function as a Service

FaaS is a type of **cloud computing service**.

It provides a platform for its users or customers to develop, compute, run and deploy the code or entire application **as functions**.

It allows the user to entirely develop the code and update it at any time without worrying about the maintenance of the underlying infrastructure.

The developed **code** can be **executed** with **response** to the **specific event**.

VIRTUALIZA TION

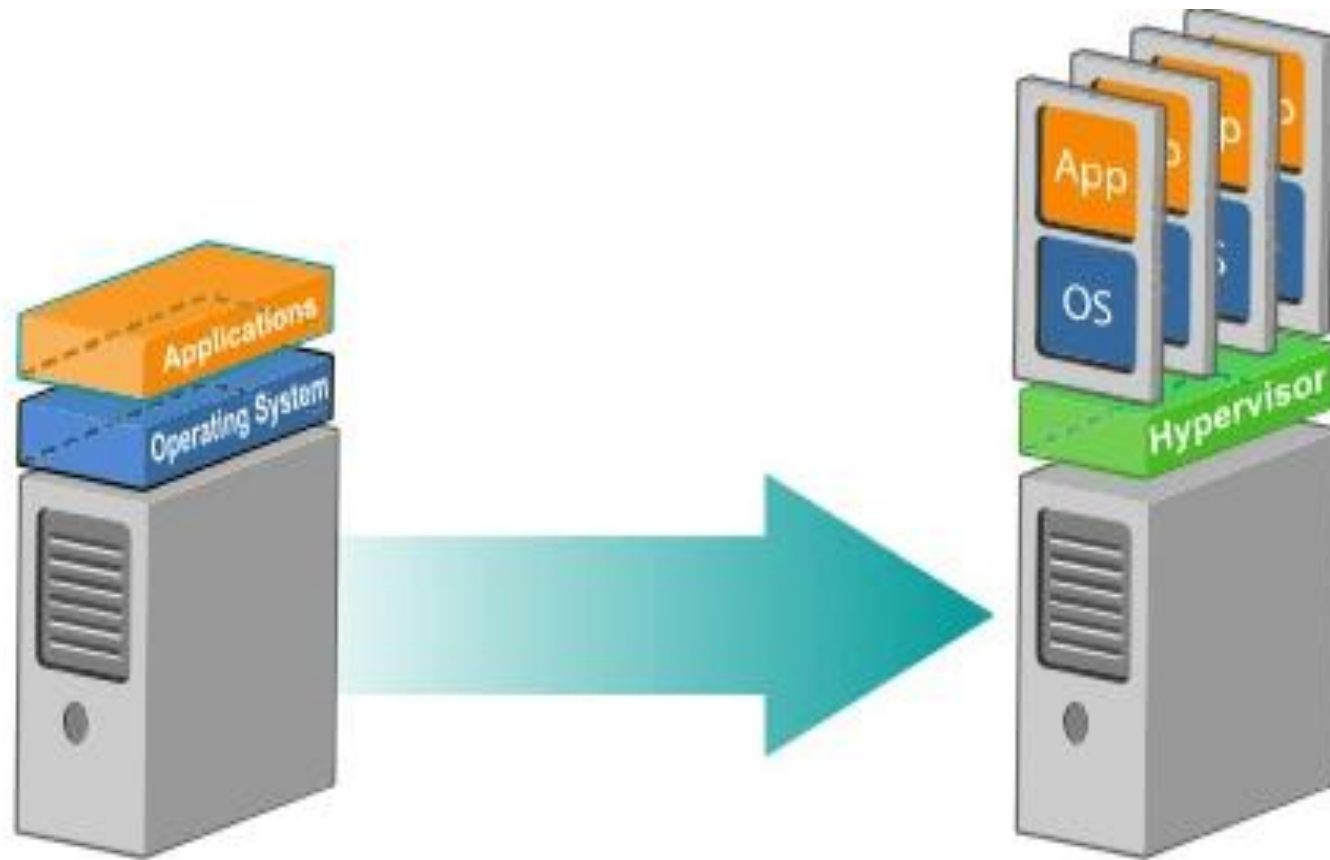
VIRTUALIZATION

Virtualization is a kind of technology that is rapidly transforming the IT landscape and has changed the way people compute.

It reduces hardware utilization, **saves energy and costs** and makes it possible to run **multiple applications** and **various operating systems** on the same SERVER at the same time.

It increases the **utilization, efficiency and flexibility** of existing computer hardware

VIRTUALIZATION ..II



VIRTUALIZATION ..III

Virtualization is technology that allows you to create **multiple simulated environments** or dedicated resources from a single, physical hardware system.

Software called a **hypervisor connects directly to that hardware** and allows you to **split 1 system** into separate, distinct, and secure environments known as **virtual machines (VMs)**.

These VMs rely on the hypervisor's ability to separate the machine's resources from the hardware and distribute them appropriately.

	Virtualization	Cloud
Definition	Technology	Methodology
Purpose	Create multiple simulated environments from 1 physical hardware system	Pool and automate virtual resources for on-demand use
Use	Deliver packaged resources to specific users for a specific purpose	Deliver variable resources to groups of users for a variety of purposes
Configuration	Image-based	Template-based
Lifespan	Years (long-term)	Hours to months (short-term)
Cost	High capital expenditures (CAPEX), low operating expenses (OPEX)	Private cloud: High CAPEX, low OPEX Public cloud: Low CAPEX, high OPEX
Scalability	Scale up	Scale out
Workload	Stateful	Stateless
Tenancy	Single tenant	Multiple tenants

Need for Virtualization

Virtualization provides various benefits including saving time and energy, decreasing costs and minimizing overall risk.

- Provides ability to manage resources effectively.
- Increases productivity, as it provides secure remote access.
- Provides for data loss prevention.

Need for Virtualization ..II

Partitioning: In virtualization, many applications and operating systems (OSes) are supported in a single physical system by partitioning (separating) the available resources.

Isolation: Each virtual machine is isolated from its host physical system and other virtualized machines. Because of this isolation, if one **virtual-instance crashes**, it doesn't affect the other virtual machines. In addition, data isn't shared between one virtual container and another.

Encapsulation: A virtual machine can be **represented** (and even stored) as a **single file**, so you can identify it easily based on the service it provides. In essence, the encapsulated process could be a business service. This encapsulated **virtual machine** can be **presented to an application** as a **complete entity**. Therefore, encapsulation can protect each application so that it doesn't interfere with another application.

VM Migration

- Migration service is the process of moving a virtual machine from one host server or storage location to another
- Different techniques of VM migration
 - Hot/live migration, cold/regular migration, and live storage migration of a virtual machine
- In this process, all key machines' components, are completely virtualized
- For e.g., CPU, storage disks, networking, memory
- Facilitating the entire state of a virtual machine to be captured by a set of easily moved data files

Migrations Techniques

- Live migration
 - Also called **hot or real-time** migration
 - The movement of a virtual machine from one physical host to another while **being powered on**
 - Without any noticeable effect from the end user's point of view (a matter of milliseconds)
 - Facilitates **proactive maintenance** upon **failure**
 - The potential problem can be resolved before the disruption of service occurs
 - Used for **load balancing**
 - **Work** is **shared** among computers **optimize the utilization** of available **CPU resources**

Migrations Techniques (cont.)

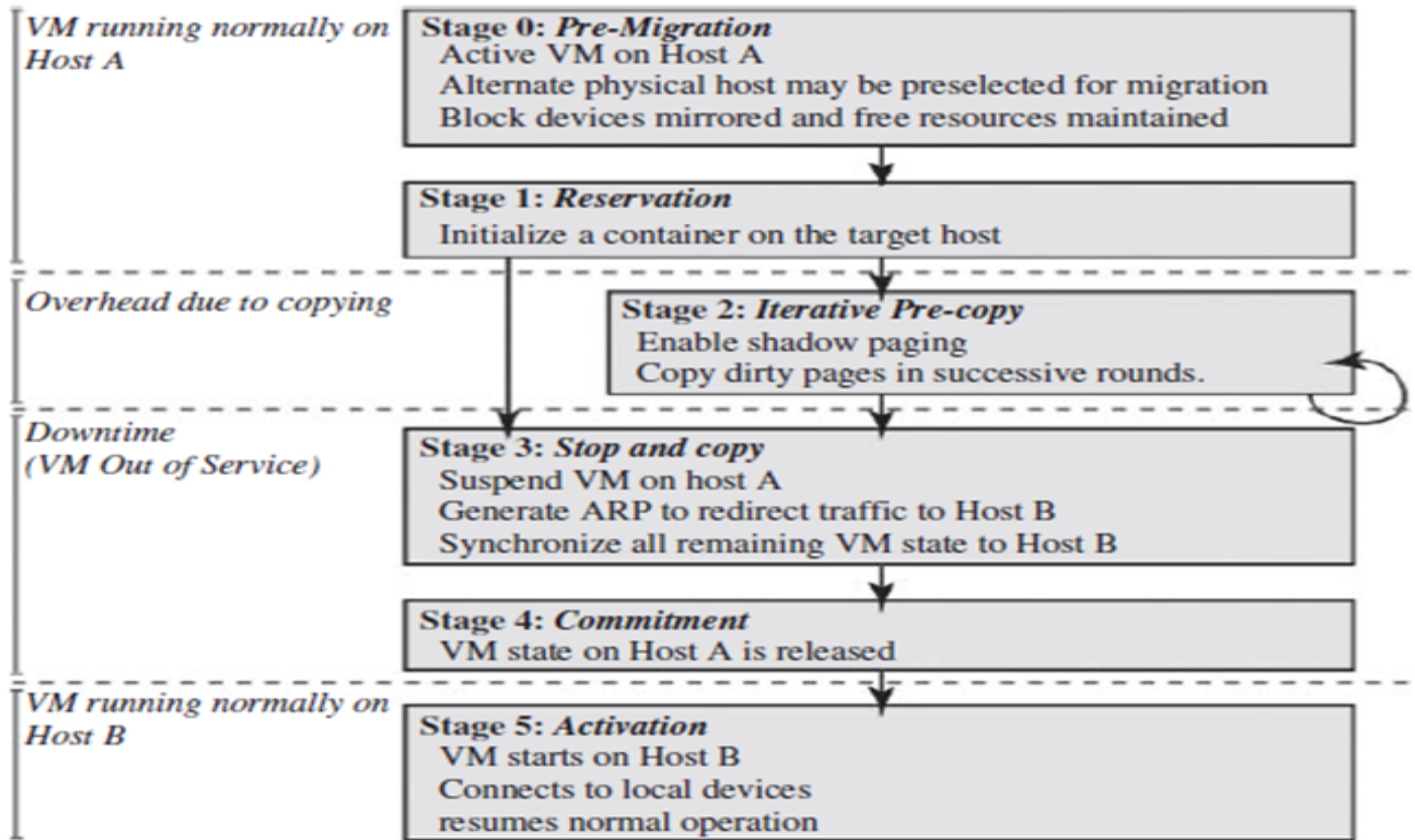
- Live migration mechanism
 - How memory and virtual machine states are being transferred through the network from one host A to another host B
 - For e.g., the Xen hypervisor
 - The process has been viewed as a **transactional interaction** between the **two hosts** involved
 - Stage 0: **Pre-Migration**
 - An **active virtual machine** exists on the physical host A
 - Stage 1: Reservation
 - A request is issued to migrate an OS from host A to B
 - The **necessary resources** exist on B and on a **VM container** of that size

Migrations Techniques (cont.)

- Stage 2: Iterative Pre-Copy
 - During the first iteration, all pages are transferred from A to B
 - Iterations copy only those pages dirtied during the previous transfer phase
- Stage 3: Stop-and-Copy
 - Running OS instance at A is suspended
 - The network traffic is redirected to B
 - CPU state and any remaining inconsistent memory pages are then transferred
- Stage 4: Commitment
 - Host B indicates to A that it has successfully received a consistent OS image

Migrations Techniques (cont.)

- Host A acknowledges this message as a commitment of the migration transaction
 - Host A may now discard the original VM
 - Host B becomes the primary host
- Stage 5: **Activation**
 - The migrated VM on B is now activated
 - **Post-migration code** runs to **reattach the device's drivers** to the new machine and advertise moved **IP addresses**
- An approach to **failure management**
 - At least one host has a **consistent VM image** at all times during migration
 - The **original host** remains **stable** until the migration commits



Migrations Techniques (cont.)

The cold migration process is simple

- The configuration files are moved from the source host to the destination host associated storage area
- Including the NVRAM file (BIOS settings), log files, as well as the disks of the virtual machine
- The virtual machine is registered with the new host
- After the migration is completed, the old version of the virtual machine is deleted from the source host

Virtual Machine Migration Techniques

Live/Hot Migration

- VM is powered on.
- Needs a shared storage for virtual machines in the server's pool.
- Certain CPU compatibility checks to be applied between hosts.
- Shortage time is very small
- Less Simple Process.

Regular/Cold Migration

- VM is powered off.
- The virtual machines are not required to be on a shared storage.
- No CPU checks are applied.
- Shortage time is large.
- Simple Process.

Integration of Private and Public Cloud

Hybrid Cloud:

Hybrid Cloud is an integration of both **Private and Public Cloud** for **high efficiency** in performing distinct functions in an organisation. For example, an environment created mixing On-premise, private cloud and public cloud (i.e GCP, AWS, Azure). This framework efficiently utilises the advantages of public resources to upscale their internal resources without risking an overload in case of unexpected spikes in usage.

- Ease of scalability.
- Cost efficiency much greater than private cloud
- Enables more **private functions** to run **on Private framework** and **sensitive functions** to run on **Public**.
- Highly secure and flexible according to organisational needs.



That's all folks for this chapter !!!!