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Cloud Fundamentals

4 IA

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Progress

- Duration: 12 Hours
  - 4 weeks ; 3 hours/lesson
- 2 Workshop
  - 3rd ,4th lessons

Chapters

1. Introduction to Virtualization
2. Cloud computing basics
3. Cloud service models
4. Cloud deployment models

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Cloud Fundamentals

Chapter 1
Introduction to Virtualization

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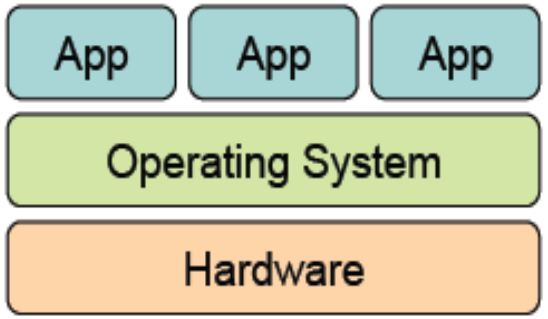
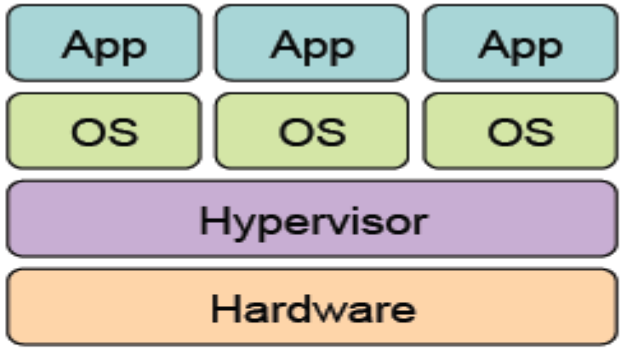
Introduction



Traditional Stack

5 to 15 % utilization only

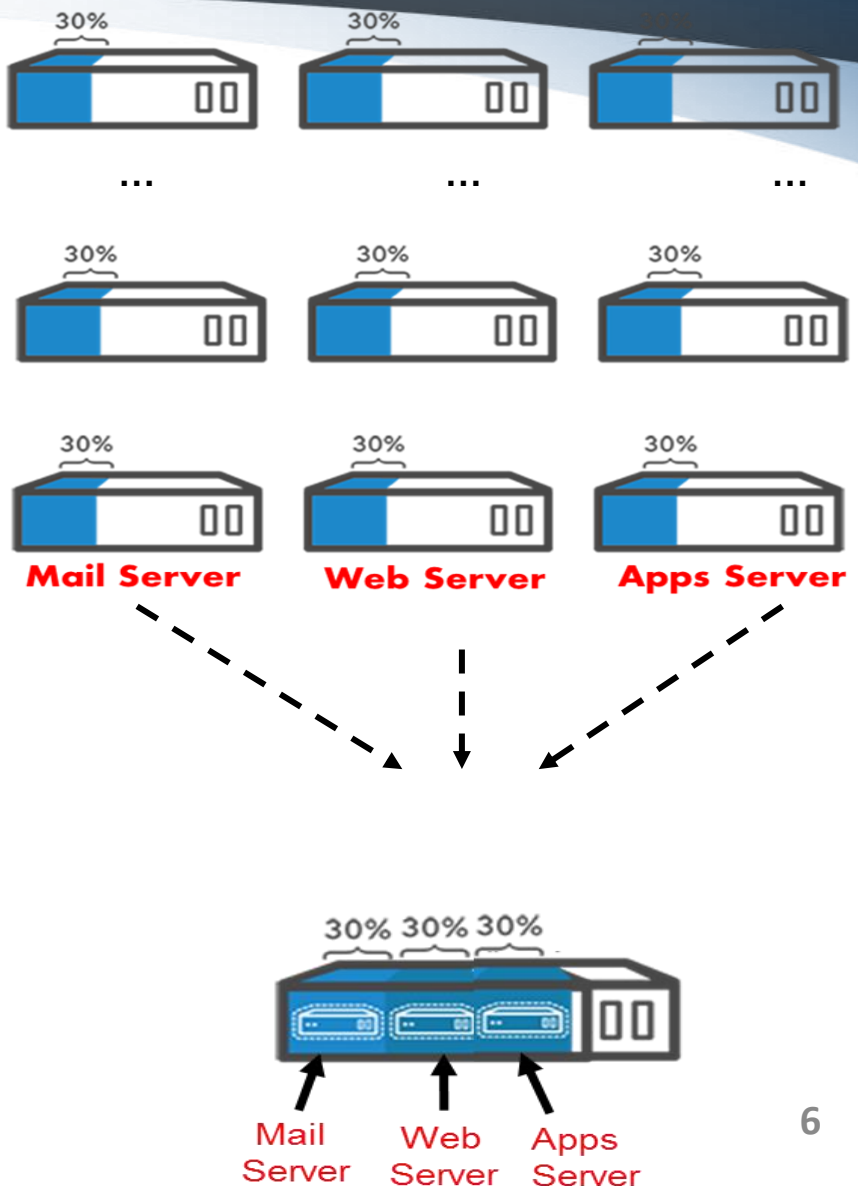


Virtualized Stack

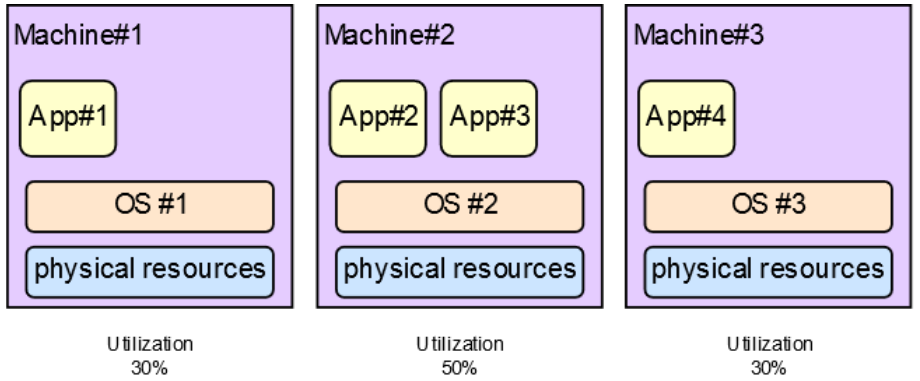
High utilization and standardization

Introduction

- **Issues of Traditional IT systems**
  - Underused and unused IT resources
    - Running one application/server to avoid hat one application will crash or bring-down with another on the same environment.
  - High maintenance and configuration costs/time
    - Spending a lot of money powering unused server capacity
    - Configuring, securing and upgrading several physical systems can be a time-wasting and costly procedure



Introduction



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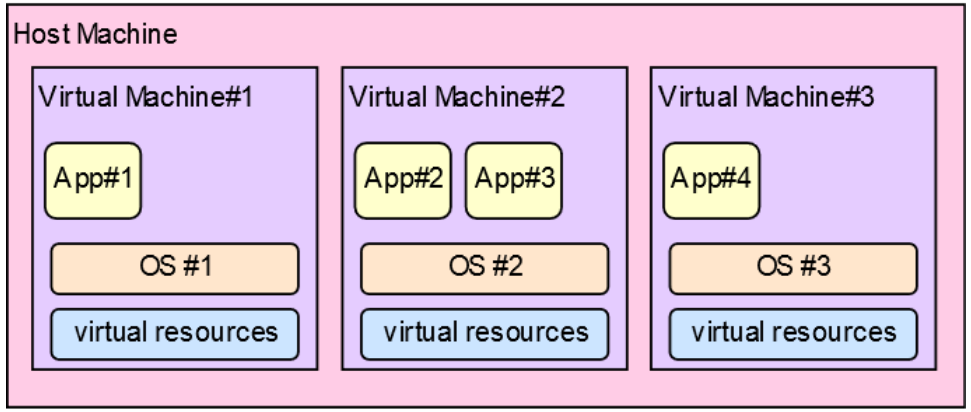

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Lesson plan

1- Virtualization definition

2- Virtualization Principles

3- Virtualization in Cloud

Virtualization Definition

Definition: Virtualization is a technique that combines the hardware and/or software techniques that make it possible to run several instances of operating systems or several applications on a single or clustered physical machine(s), concurrently and separately from one other.

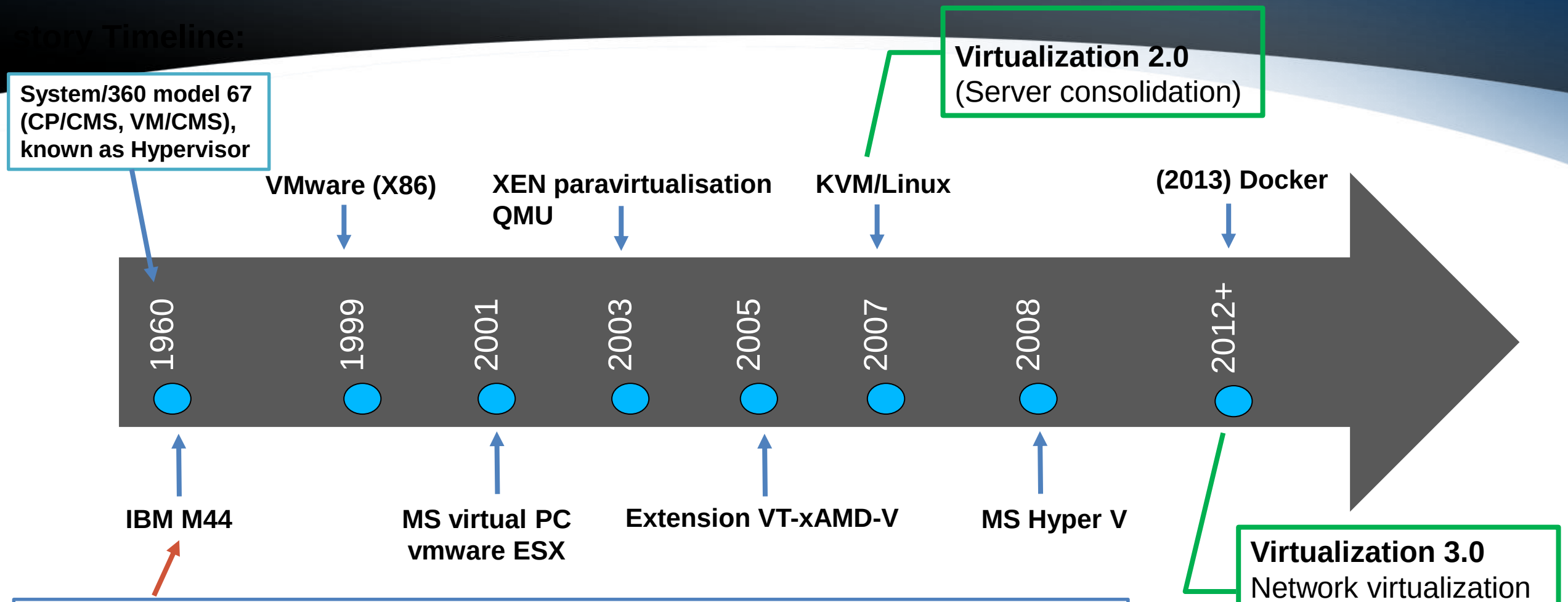
- Virtualization facilitates the abstraction of the physical characteristics of computing resources to simplify the way in which other systems, applications, or end users interact with those resources.

✦The resources of the physical machine (e.g., disk space, RAM, CPU) are shared with the virtual machine (VM).

✦A virtual machine behaves exactly like a physical computer and contains its own hardware resources that are virtual.

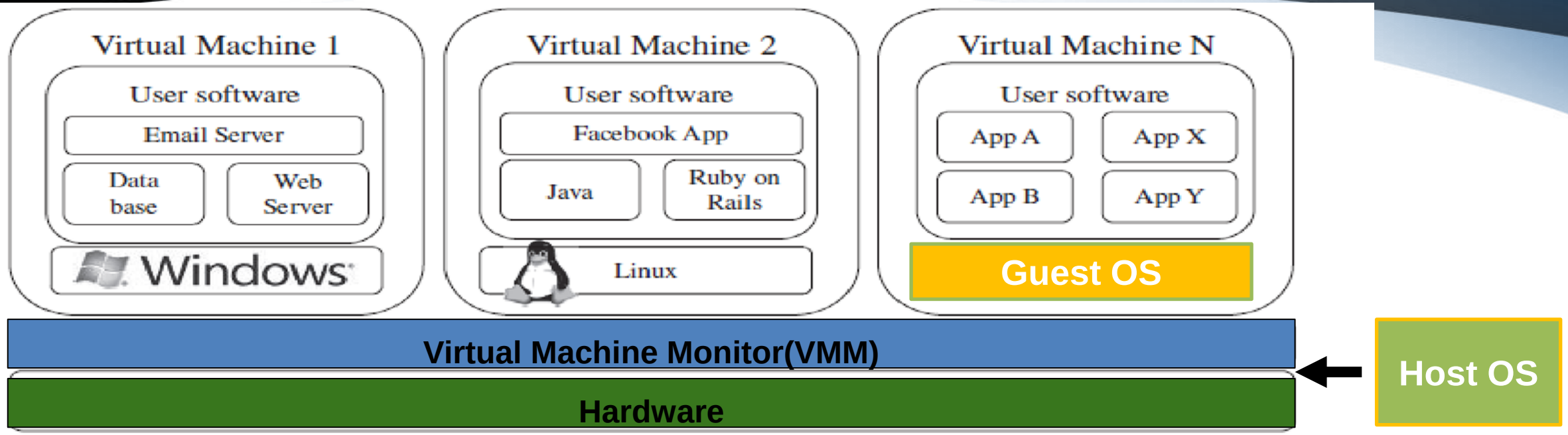
Virtualization Definition

story Timeline:



- Virtualization has its origins in the mainframe days in the late 1960s and early 1970s,
- IBM invested a lot of time and effort in developing robust time-sharing solutions.

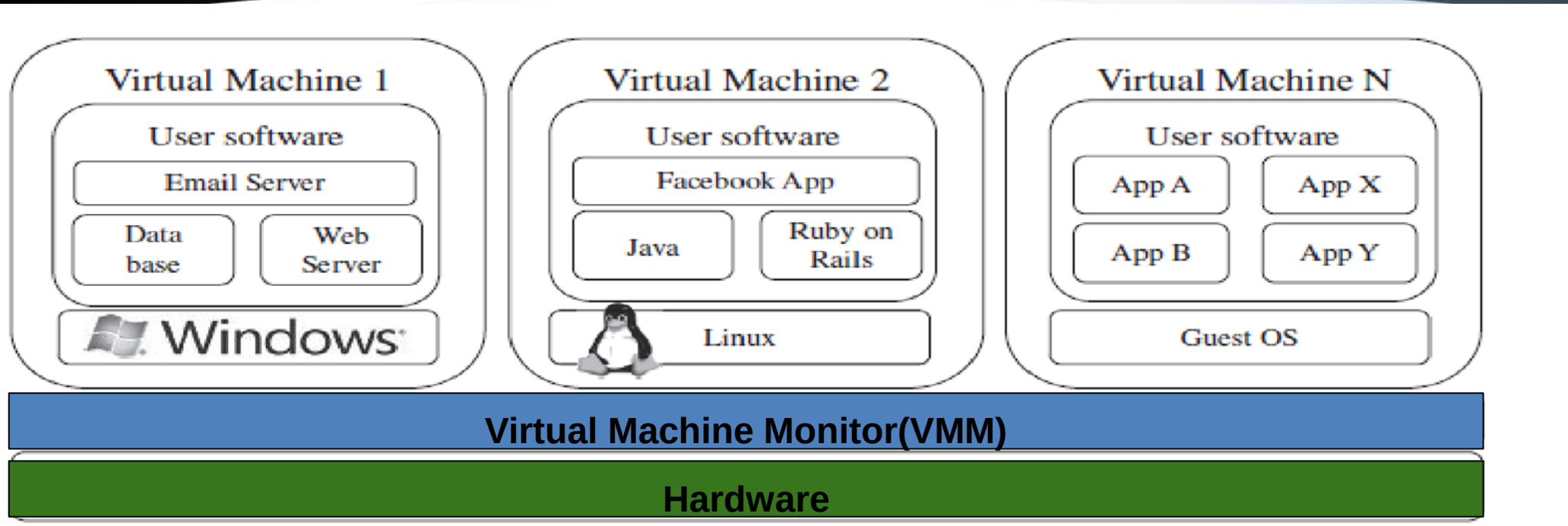
Virtualization Definition



A hardware virtualized server hosting three VMs, each one running distinct OS and user level software stack.

- **The host system**: is the main operating system that runs under the control of the hardware.
- **The guest system**: is the operating system installed inside a virtual machine.
- **The virtual machine**: an isolated environment that appears to be a whole computer, but actually only has access to a portion of the computer resources. It can be created using VirtualBox, for instance.

Virtualization Definition

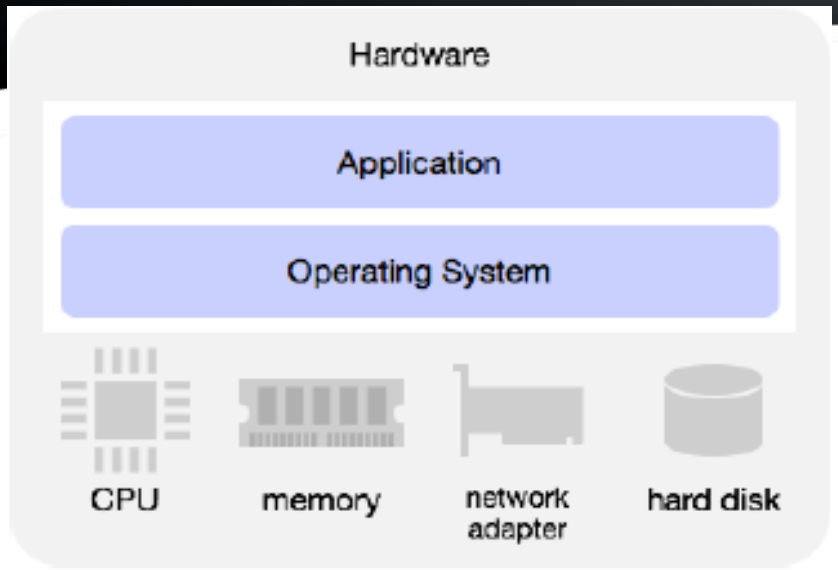


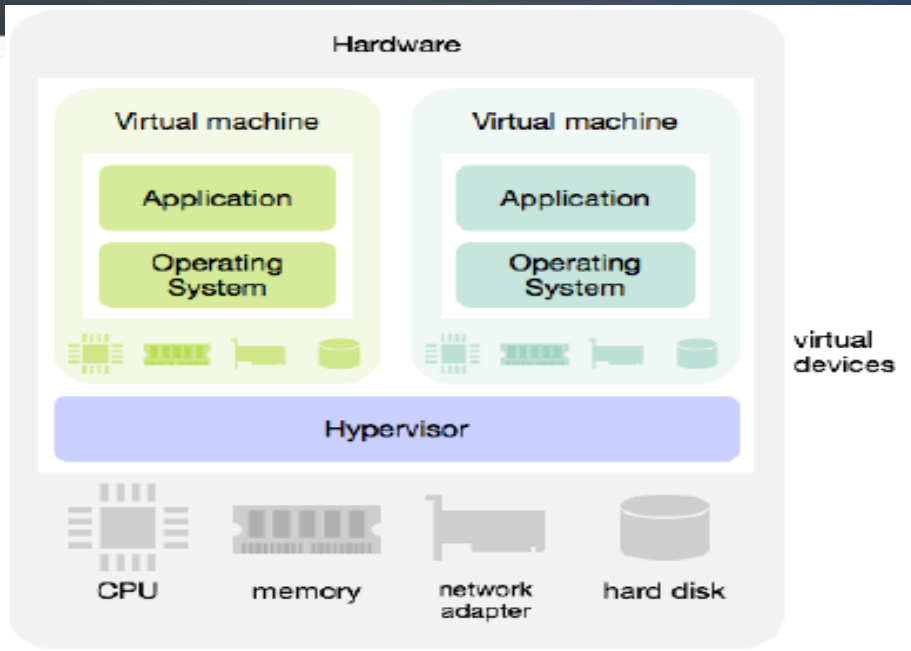
A hardware virtualized server hosting three VMs, each one running distinct OS and user level software stack.

- **Virtual Machine Monitor (VMM):** is the control system at the core of virtualization. It acts as the control and translation system between the VMs and the hardware.
  - VMM properties: Fidelity, Performance, Safety and Isolation

Virtualization Principles

Comparison between a virtualized and non-virtualized resource





Without virtualization

- One machine, one OS
- The OS manages the physical components:
  - CPU, Memory, Hard-disk, Network adapter, ...
- Conflicts when multiple applications run on the same machine
- Underutilized resources
- Is inflexible and expensive

With virtualization

- Subdivision of a PM into several VMs
- Physical devices are shared between VMs.
- Isolates VM from each other, hence no conflict
- Improves resource utilization
- Offers flexible infrastructure at low cost

Hypervisor-based Virtualization

- A hypervisor (also known as VMM) is a software that allows multiple OSs to run concurrently on a physical machine and to interact directly with the physical hardware.
- Has two components:
  - Kernel: (OS services) Process creation, file system management, process scheduling, etc..
  - Virtual Machine Monitor (VMM)

- **Hypervisor types:**
  - Para-virtualization (Hypervisor type 1, Native or Bare-Metal): installed and runs directly on the physical hardware and can in theory exists without any accompanying operating system.
  - Full virtualization (Hypervisor type 2 or Hosted): VM simulates hardware to allow an unmodified guest OS to be run in isolation.

Virtualization Principles

Virtualization simulates the interface to a physical object by any one of four means:

Multiplexing: Create multiple virtual objects from one instance of a physical object.

Example: a processor is multiplexed among a number of processes or threads.

Aggregation: Create one virtual object from multiple physical objects.

Example: a number of physical disks are aggregated into a RAID disk.

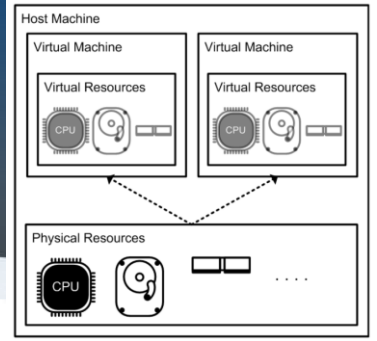
Emulation: Construct a virtual object from a different type of physical object.

Example, a physical disk emulates a random access memory.

Multiplexing and emulation:

Examples: Virtual memory with paging multiplexes real memory and disk, and a Virtual address emulates a real address; TCP emulates a reliable bit pipe and multiplexes a physical communication channel and a processor.

Virtualization Principles

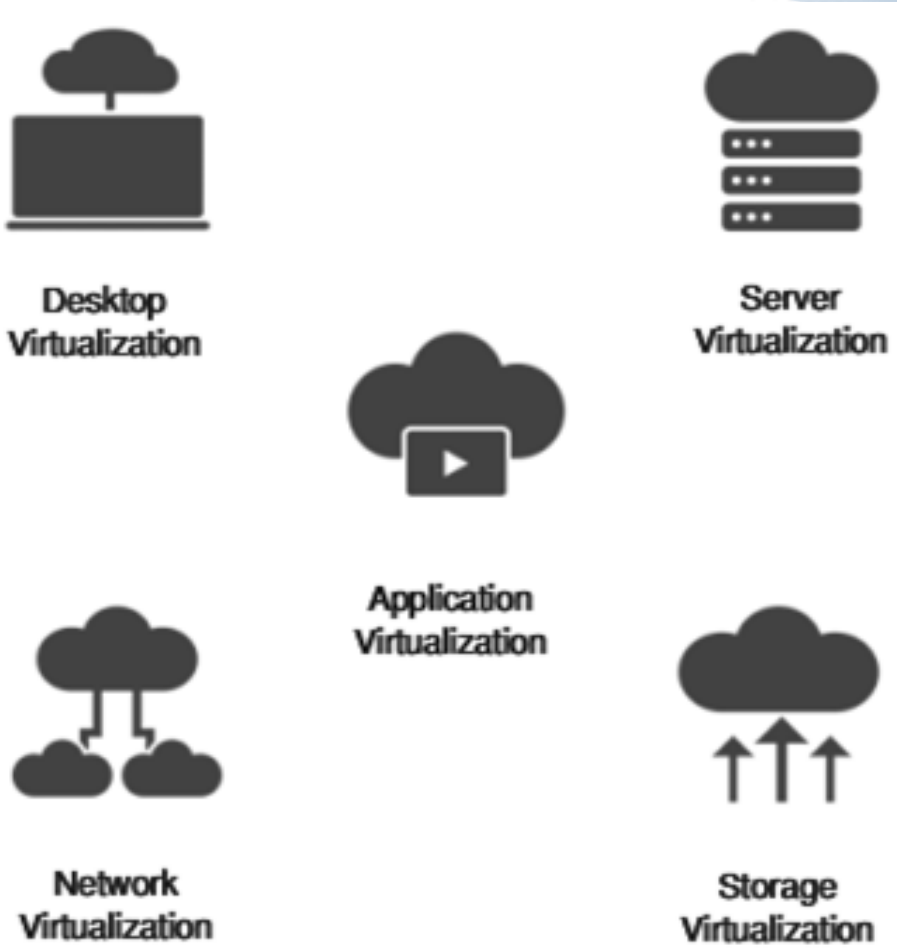


Virtualization has four characteristics that make it ideal for CC:

- **Partitioning:** you can use partitioning to support many applications and (OSes) in a single physical system.
- **Isolation:** Because each virtual machine is isolated, each machine is protected from crashes and viruses in the other machines.
  - What makes virtualization so important for the cloud is that it decouples the software from the hardware.
- **Encapsulation:** Encapsulation can protect each application so that it doesn't interfere with other applications.
  - A virtual machine can be represented/stored as a single file, making it easy to identify and present to other applications.
- **Hardware Independence:** Provision or migrate any virtual machine to any physical server.

Virtualization Principles

- Desktop virtualization
- Server virtualization
- Software/Application virtualization
- Network virtualization
- Storage virtualization



Virtualization Benefits

Fewer servers

Simplify the administration of resources

Enhanced Security

Optimizing Performance

Stability and reliability

Simplify the deployment of virtual machines

Reduced costs

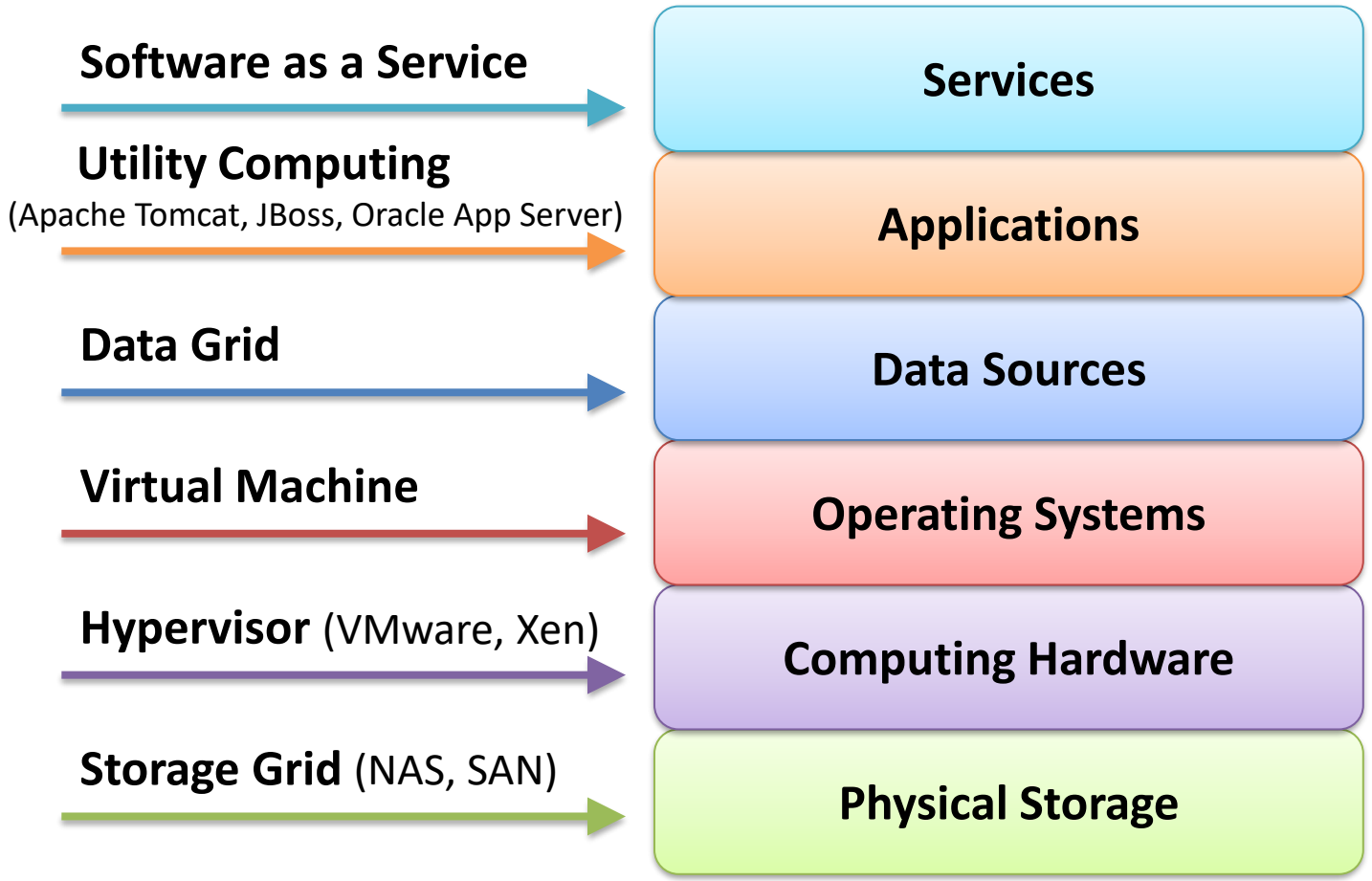
Power and space reduction

Virtualization in Cloud

- Virtualization has been in data centers for several years as a successful IT strategy for consolidating servers.
- Virtualization is a foundational element of cloud computing and helps deliver on the value of cloud computing
- Virtualization is transforming the face of the modern data center, it offers consolidation and improved IT operational efficiency.
- Virtualization can provide the basic building blocks for your cloud environment to enhance agility and flexibility.

Virtualization in Cloud

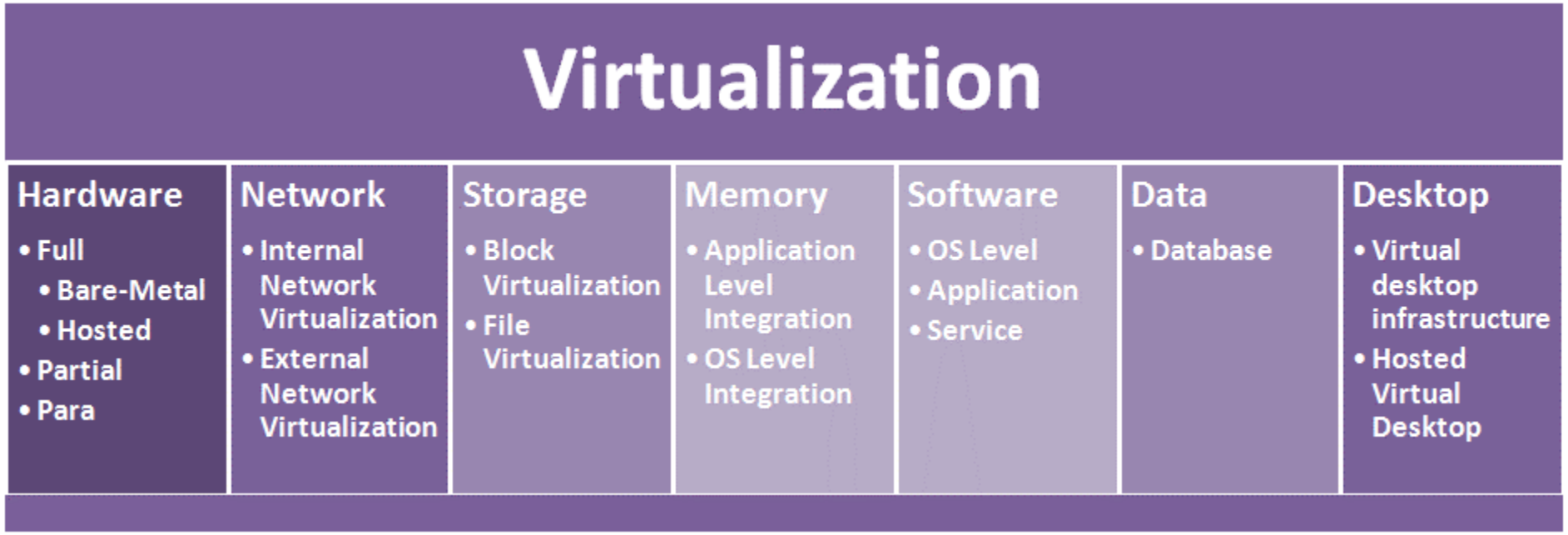
Virtualization layers



Virtualization in Cloud

- Resource optimization and efficient load balancing: distribution of virtual machines on physical machines according to the respective loads;
- Consolidation provides a cost and time effective mutualization (e.g., electricity consumption, physical maintenance, monitoring, support, hardware compatibility, etc.)
- Easy installation, backup, deployment and migration of virtual machines and applications;
- Securing and / or isolating a network;
- Decrease the risks associated with server sizing when defining the architecture of an application, the addition of resources become transparent;
- Automatic recovery during incidents. Virtualization improves prevention and fault management as well as the system's recovery plan.

Virtualization in Cloud



Virtualization in Cloud Challenges

- **Extra Costs:** Virtualization tools are very resource-intensive applications and require powerful machines that cost more than more-conventional servers. Management of new tools requires increased headcount and training.
- **Availability:** Several virtual environments run on a single physical machine, if this machine fails, then the services provided by the virtual environments are interrupted. Migration to virtualization without considering an effective disaster recovery plan (Disaster Recovery Plan), can be fatal to your information system.
- **Congested storage network:** data storage traffic can dramatically results in large amounts of data generated from multiple guests through one host storage network connection (e.g., NFS), which can cause instant bottlenecks, flooding, and congestion. Data pipes can’t handle the massive data volumes
- **Complexity of Virtual Infrastructure Configuration:** Although virtualization offers valuable benefits for IT organizations, it adds levels of complexity. All the resources, both virtual and physical must be tracked, managed, maintained and their performance managed.