

Virtualisation

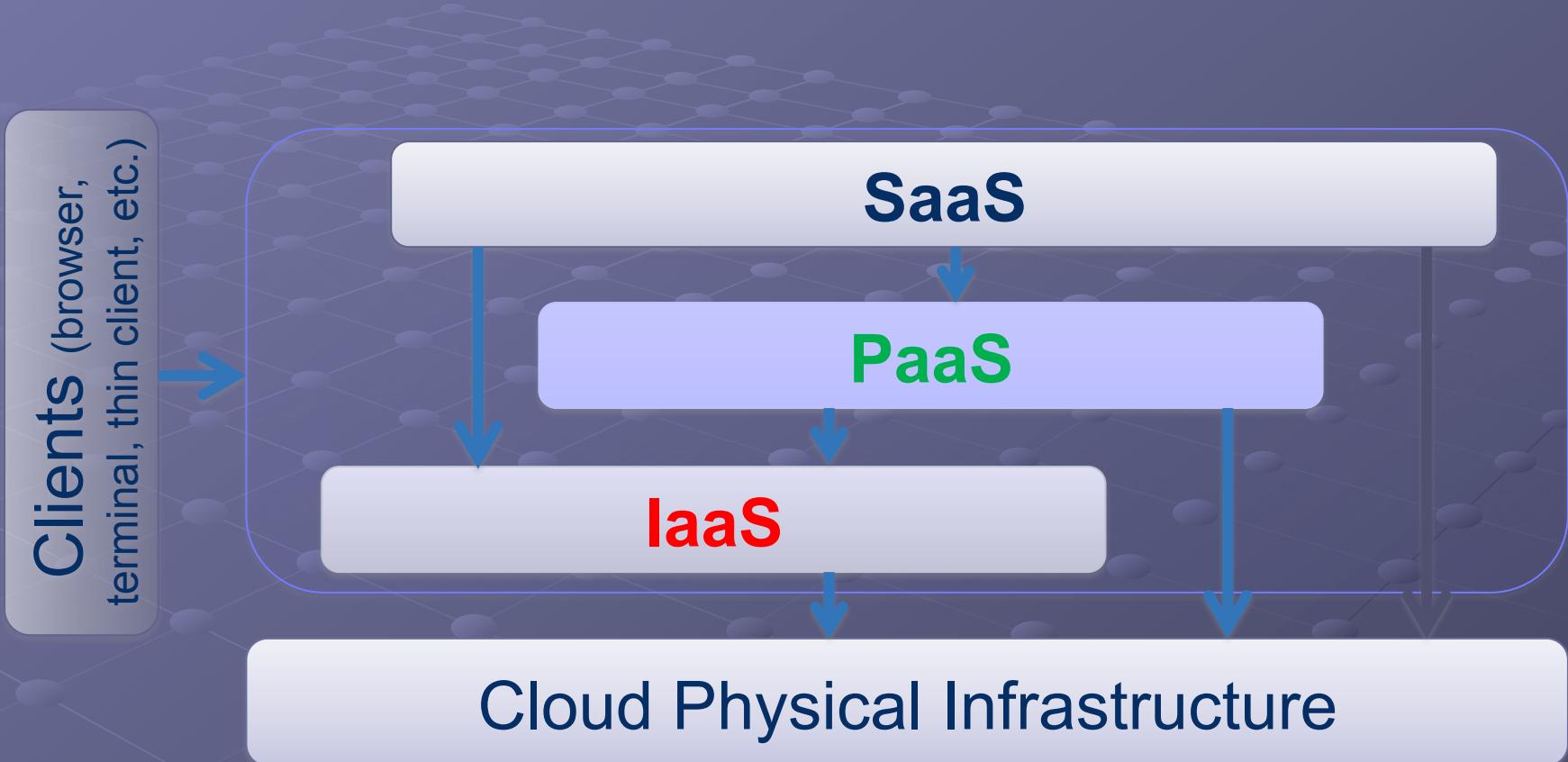
Prof. Tahar Kechadi

School of Computer Science & Informatics

Outline

- Introduction to Virtualisation
- History of Virtualisation
- Virtualisation Technology (VT)
- Types of Virtualisation
- Pros and Cons

Keep the hierarchy in mind!



Introduction

- **What is Virtualisation?**

- The use of hardware and software to create the perception that one or more entities exist

- **Why it is interesting?**

- One server appear to many
- Desktop computer appear to be running multiple OS simultaneously
- Network connection
- Vast amount of disk space

Standard Interfaces

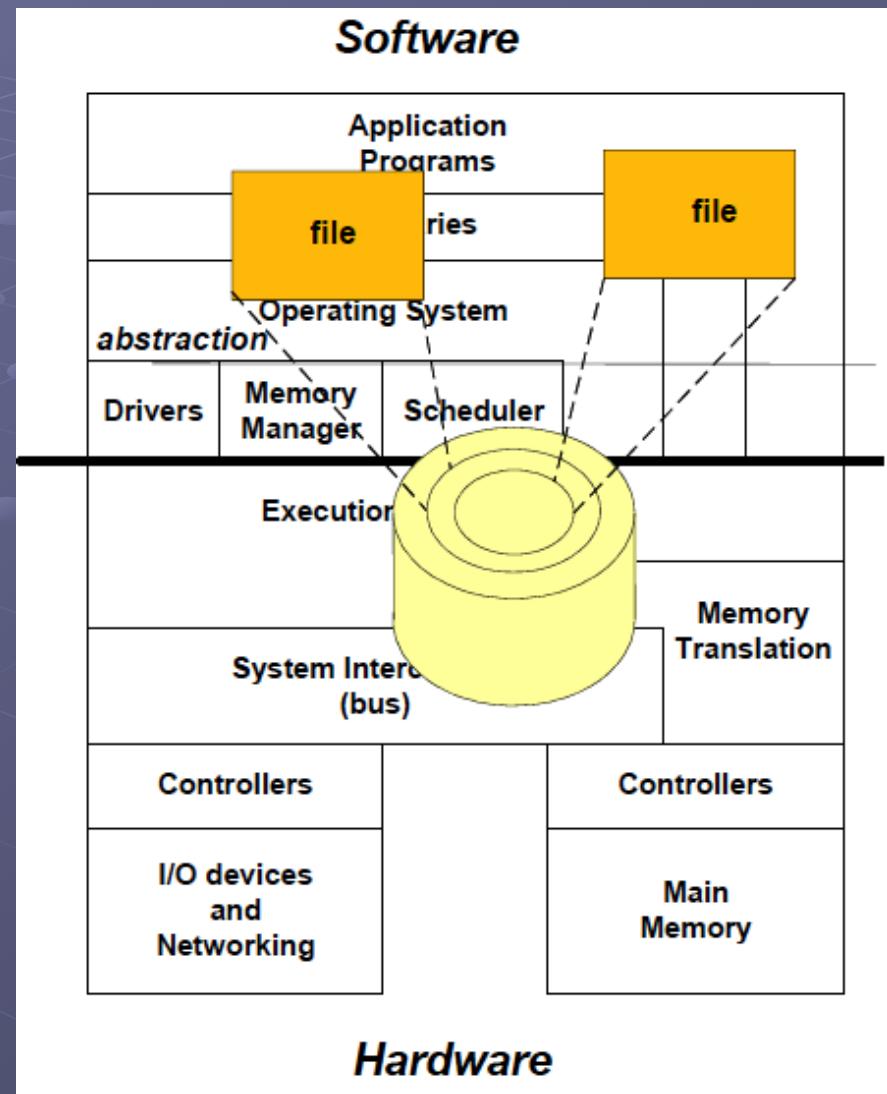
- Major design tasks are decoupled
- Different hardware and software development schedules
- Software can run on any machine *supporting a compatible interface*

Disadvantages

- Software compiled for one ISA will not run on hardware with a different ISA
 - Apple Mac (PowerPC) binaries on an x86? No
- Even if ISAs are the same, OSes may differ
 - Windows NT applications on a Solaris x86? No

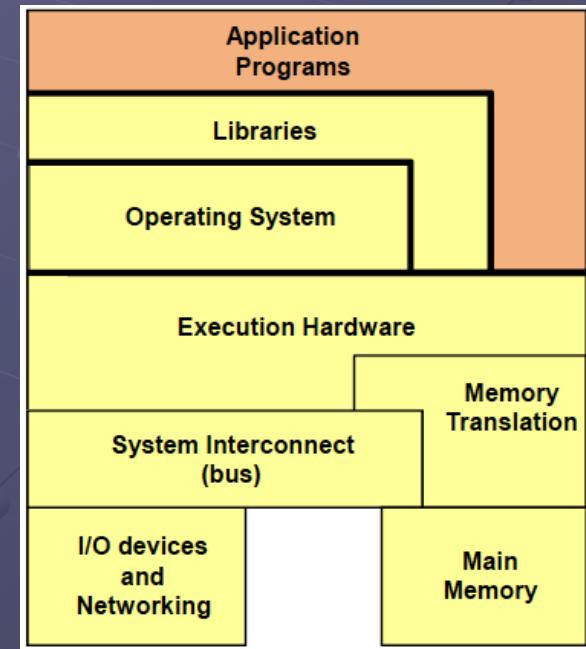
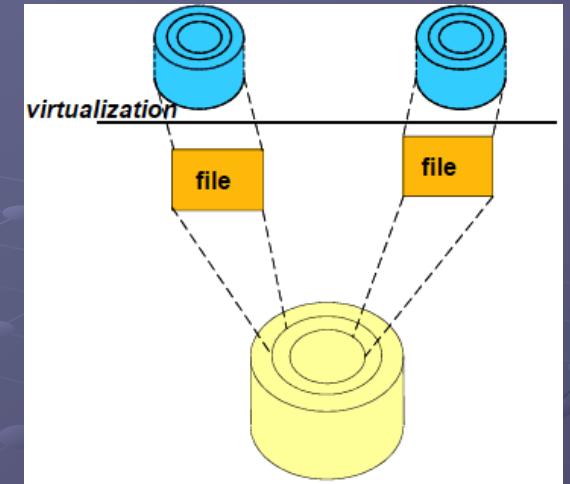
Abstraction

- Computer systems are built on levels of abstraction
- Higher level of abstraction hide details at lower levels
- Example: files are an abstraction of a disk



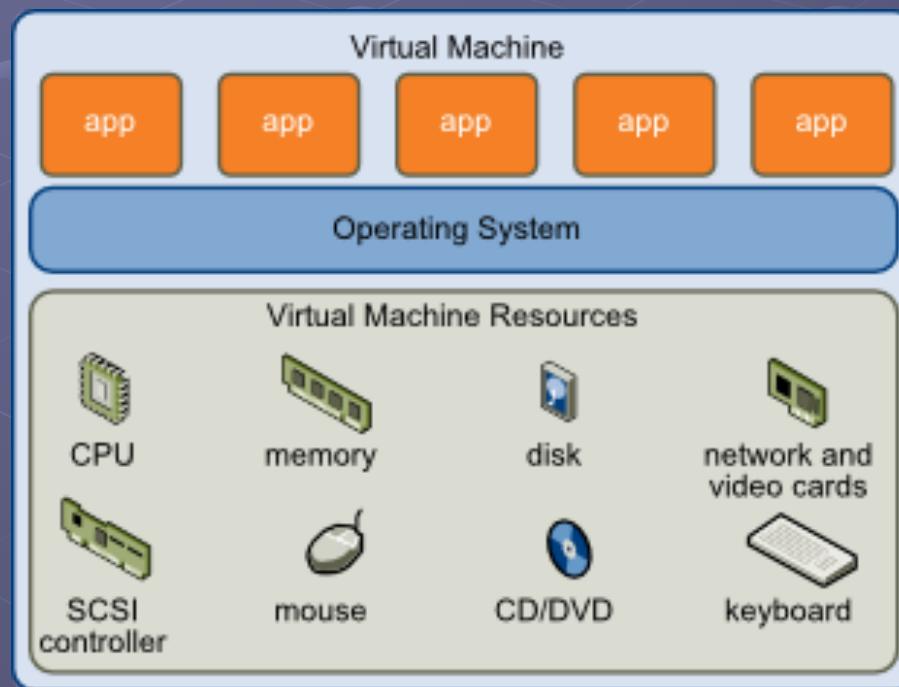
Virtualisation

- An isomorphism from guest to host
 1. Map guest state to host state
 2. Implement “equivalent” functions
- Similar to abstraction
- Construct Virtual Disks
 - Files on a larger disk
 - Map state
 - Implement R/W/F/D function
- VMs: do the same thing with the whole “machine”



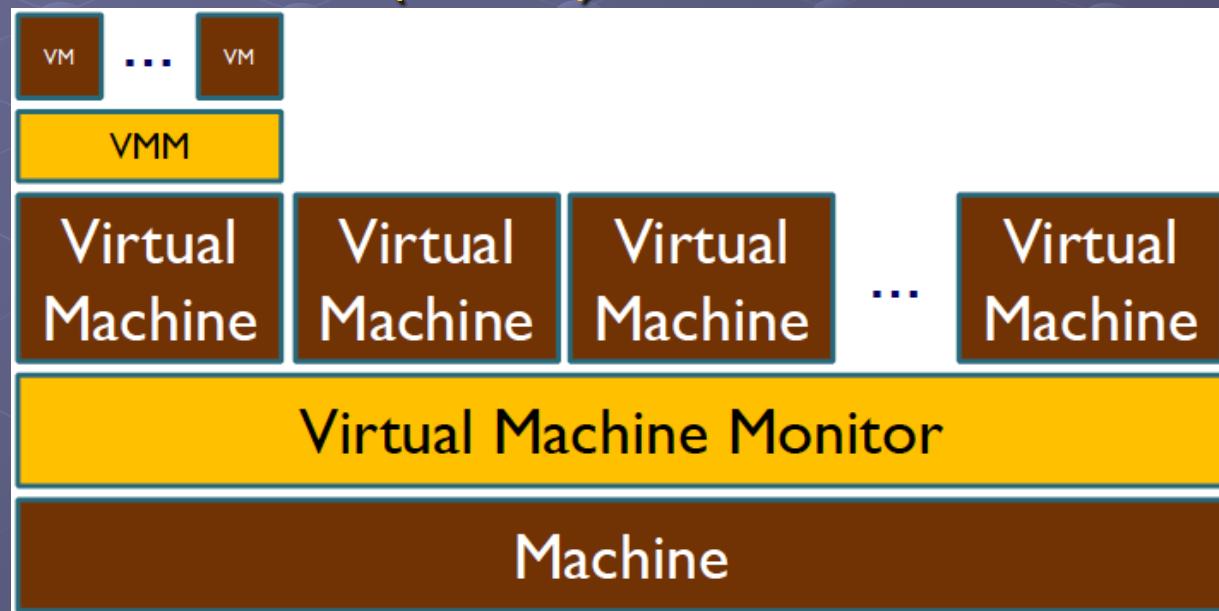
Virtual Machine

- Add Virtualizing Software to a Host platform and support Guest process or system on a Virtual Machine (VM)

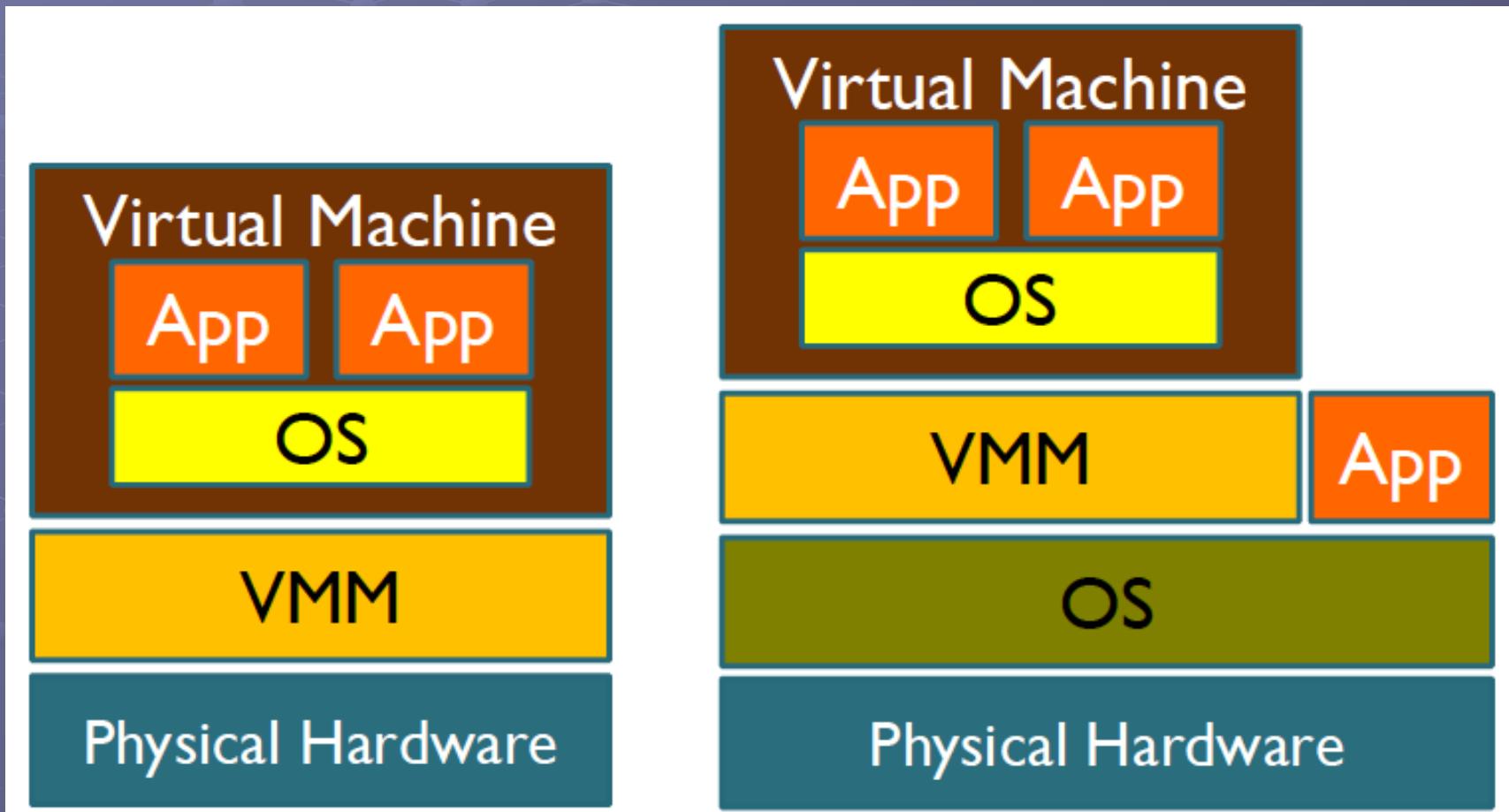


Virtualisation Technology (VT)

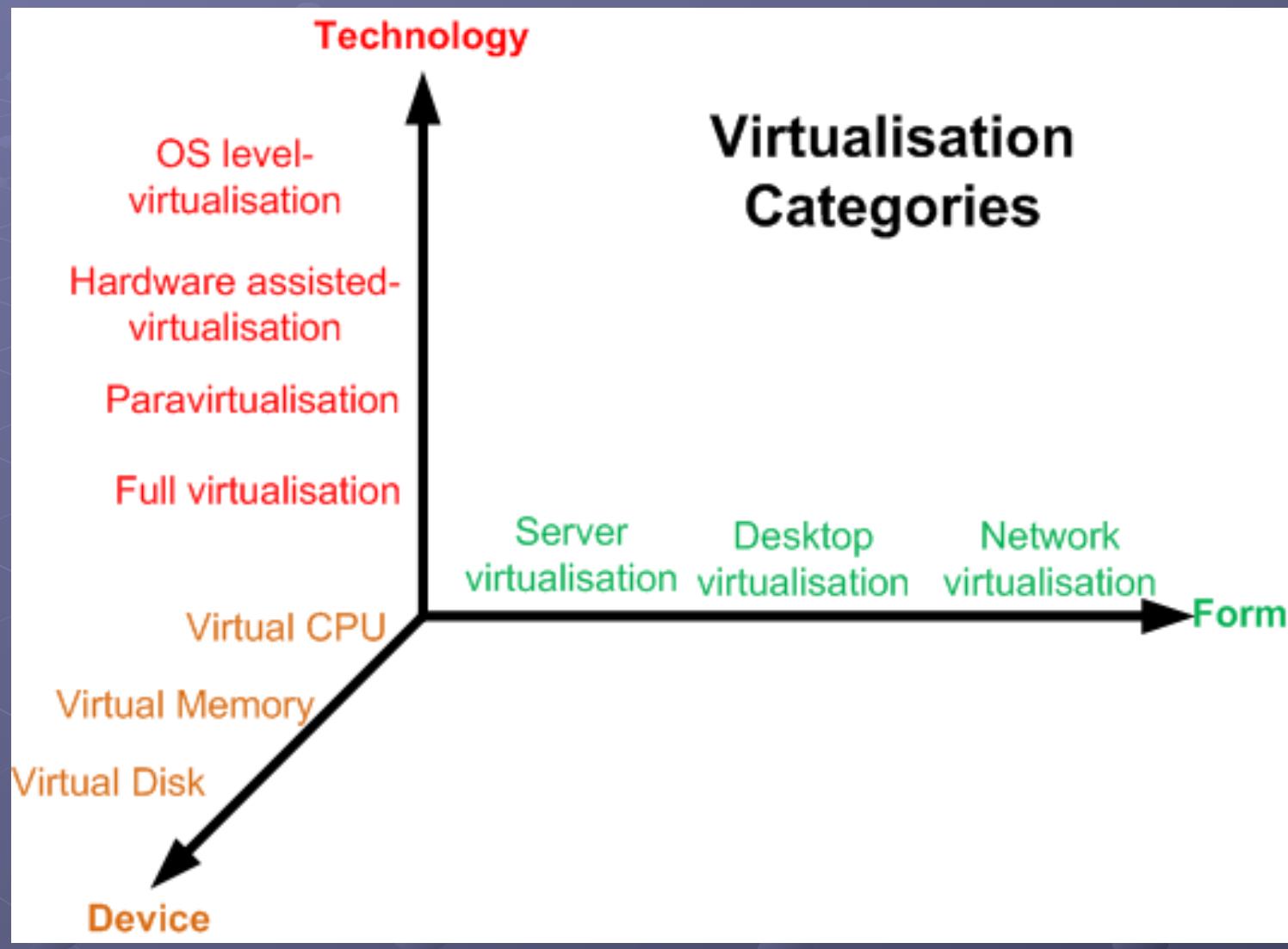
- Was dormant for decades because of its overhead
- Has became active after recent advanced in hardware and software technologies
- Two main concepts: Virtual Machine (VM), Virtual Machine Monitor (VMM)



VT Categories

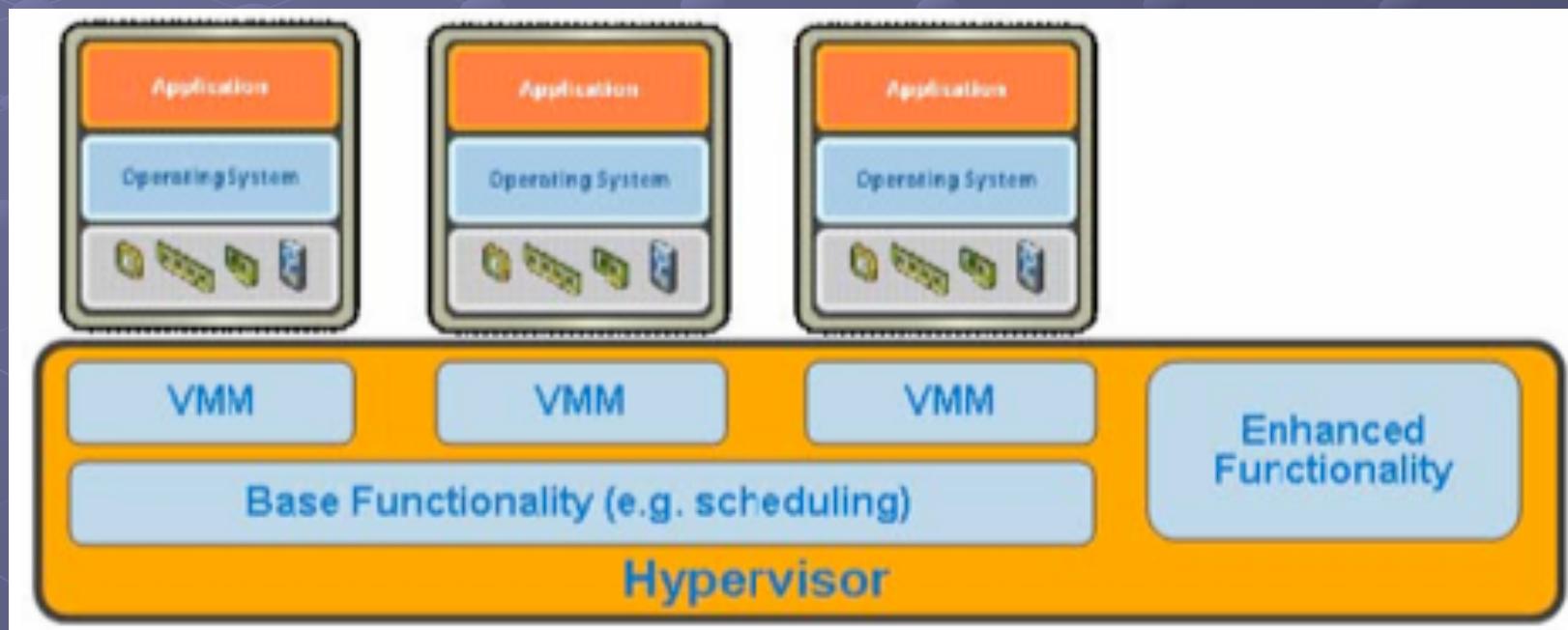


Virtualisation Categories



Hypervisor

- Manage VMs
- Create a simulated computer environment for the guest software

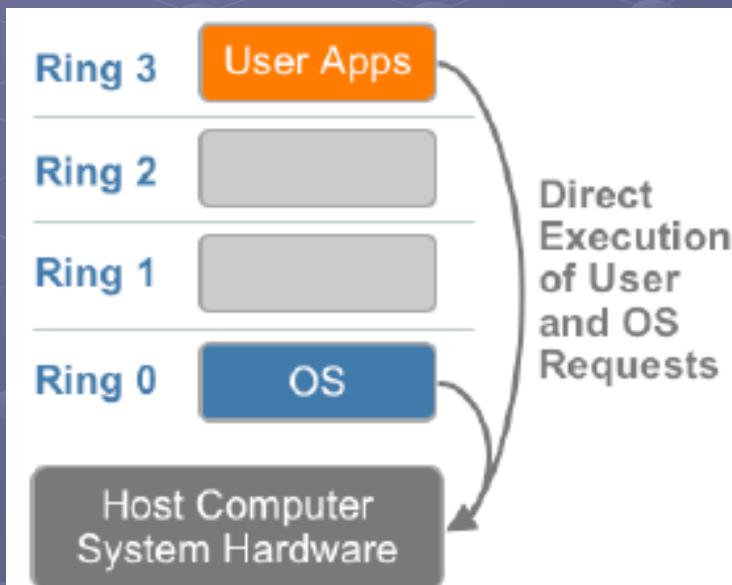


(VMWare)

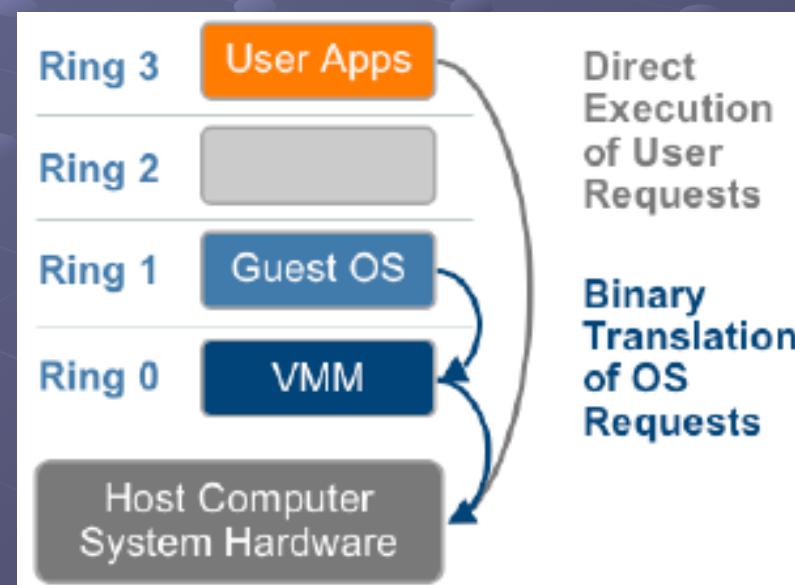
Full Virtualisation

- The host emulates a complete installation, including hardware layer, for each guest

Ex: VMWare's, MS Virtual Server



Privilege level architecture



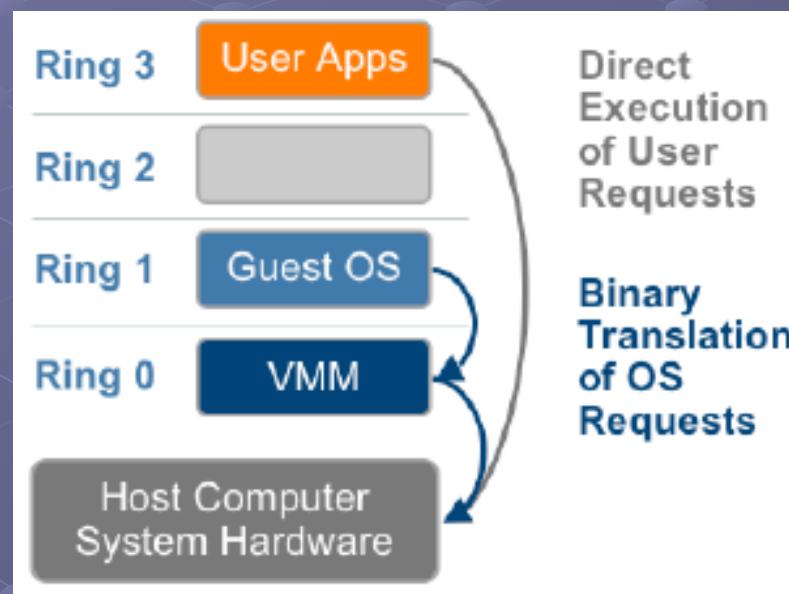
(VMWare)

Full virtualisation

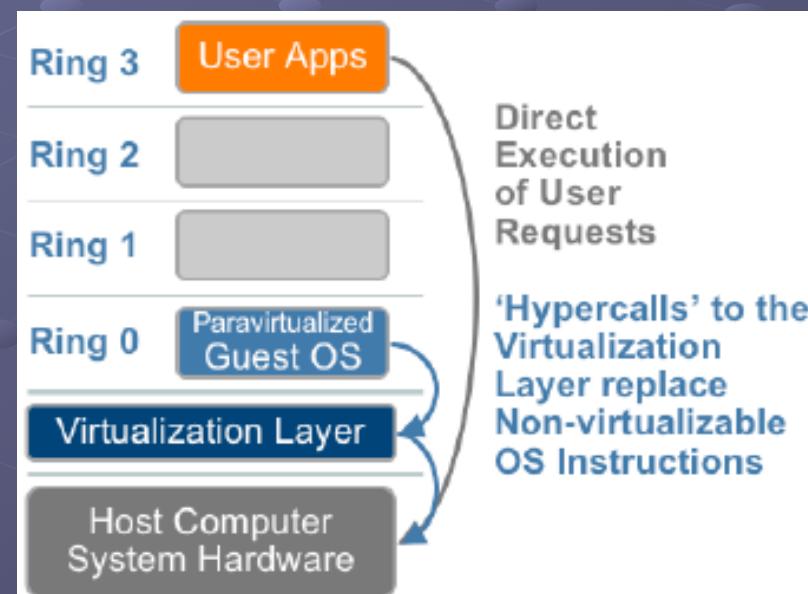
Paravirtualisation

- Modifying the OS kernel to replace nonvirtualizable instructions with hypercalls that communicate directly with the virtualisation layer hypervisor.

Ex: Xen Server



Full virtualisation

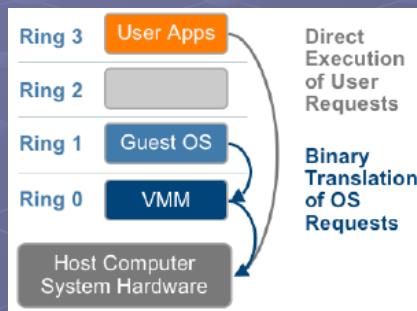


Paravirtualisation

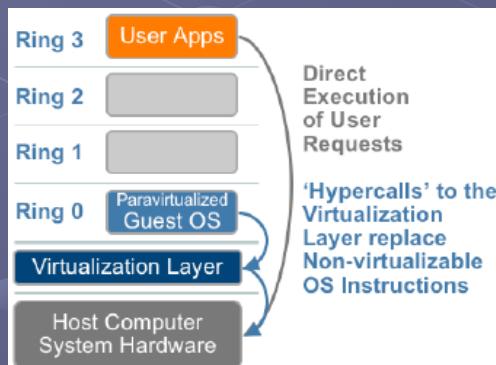
(VMWare)

Hardware-Assisted Virtualisation

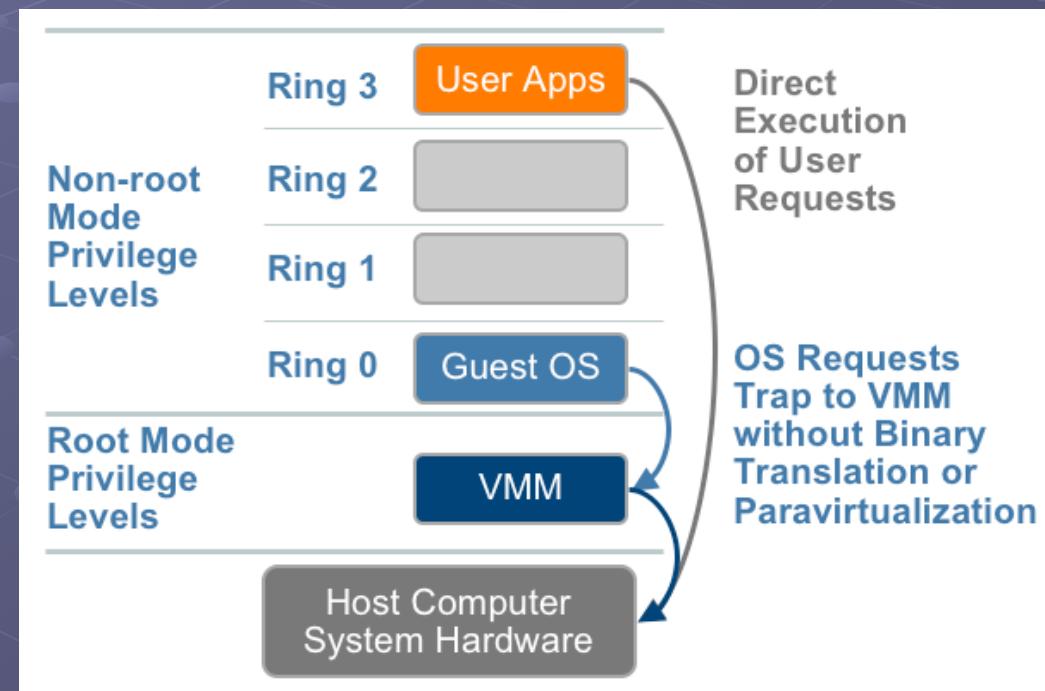
- Technology that allows for a CPU instruction set communication in which the VMM runs in a new root level mode below the OS kernel level. Ex: VT-x, AMD-V



Full virtualisation



Paravirtualisation



Hardware-Assisted Virtualisation

(VMWare)

Forms of virtualisation

- **Server virtualisation**
 - One server appear as many
 - Virtual server may run the same or different operating systems
- **Desktop virtualisation**
 - Support for multiple OSs
 - Switch between OSs
- **Virtual Networks**
 - VPN
 - Connect to a network and access the network resources from any Internet-connected computer
- **Virtual Storage**
 - Access scalable and redundant physical storage through the use of abstract or logical disk drives, file systems or DBs

Pros and Cons

- Pros:

- Increase: device utilisation, user access, flexibility
- Decrease: device footprint, power consumption
- Improve: use and management of software, capacity planning, disaster recovery
- Simplify OS and application administration
- Scalability

- Cons:

- Not all applications are well suited for virtualisation (ex: Graphics-intensive applications)
- Overhead

Summary

- Define Virtualisation and Virtualisation technology
- Types of virtualisation
- Pros and Cons of virtualisation