Virtualisation

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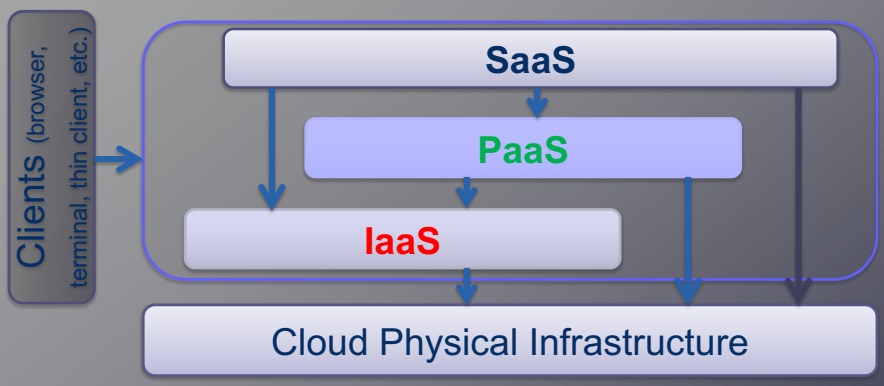
Learning Outcomes

- Define Virtualisation
- Discuss a brief history of Virtualisation
- Understand Virtual Machines
- Describe Types of Virtualisation
- Understand Advantages and Disadvantages of VMs

Keep the hierarchy in mind!

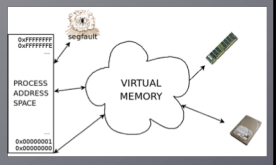


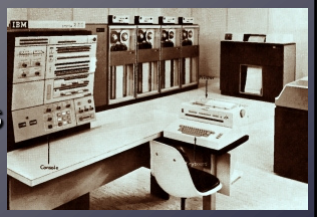
Introduction

- What is Virtualisation?
  - Is the illusion of creating or having two or more entities where there is only one physical entity in the system
- Why it is interesting?
  - Making one server appear to be many
  - Desktop appears to be running multiple OS simultaneously
  - Virtual Network: VPNs
  - Virtual Storage: Vast amount of disk space

Some History

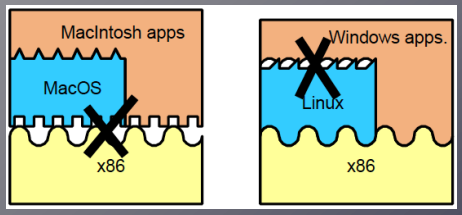
- Virtualisation
  - Is not a new idea
  - Virtual Memory
  - Virtual processors (processes)
  - IBM developed virtual OS (> 30 years ago)
- Key Concepts
  - Provide virtual resources
  - Provide portability to applications





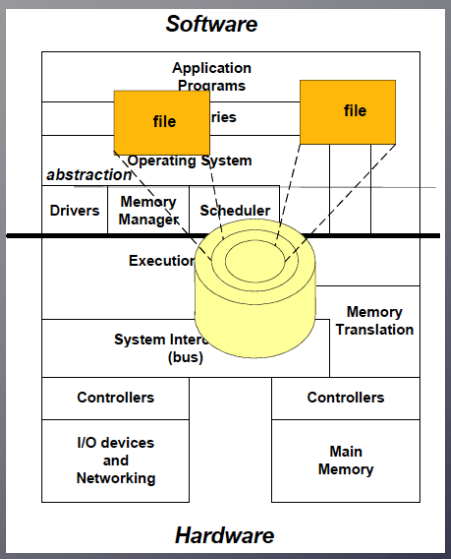
Issues

- Without Virtualisation
  - 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, OSs may differ
  - Windows NT applications on a Solaris x86? No



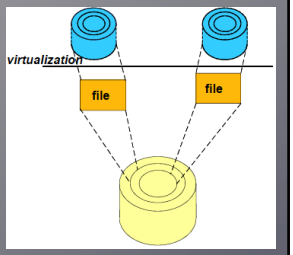
Abstraction

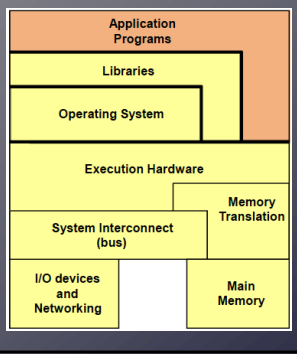
- Computer systems are built on levels of abstraction
- Higher level of abstraction hide details at lower levels
- Example: files are an abstraction of a disk



Virtualisation

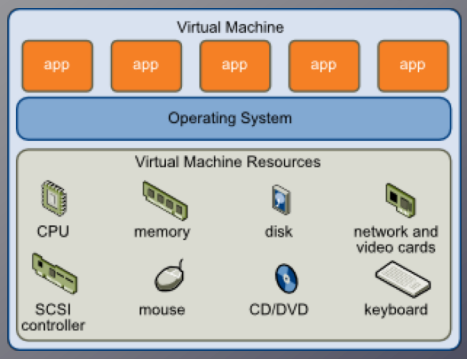
- An isomorphism from guest to host
  1. Map guest state to host state
  2. Implement "equivalent" functions
- Similar to abstraction
- Construct Virtual Disks
  - Files on a larger disk
  - Map state
  - Implement R/W/F/D functions
- VMs: do the same thing with the whole "machine"





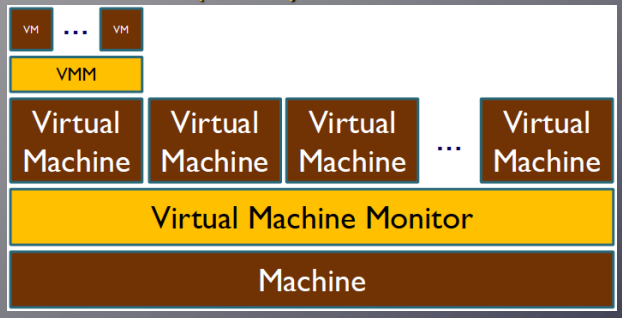
Virtual Machine

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

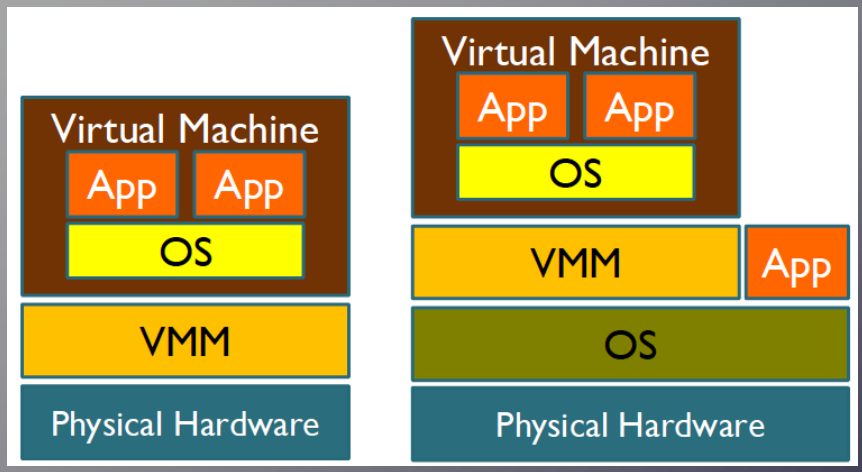


Virtualisation Technology

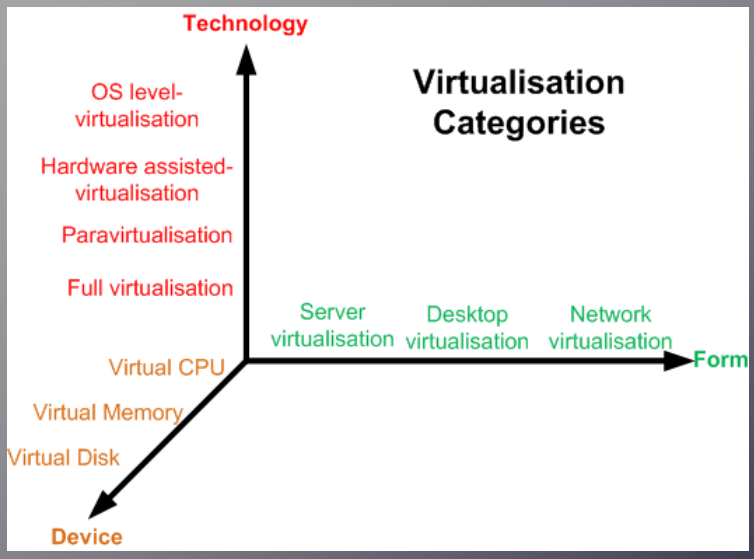
- Was dormant for decades because of its overhead
- Has became active after recent advanced in hardware and software technologies
- Two main concepts: Virtual Machine (VM), Virtual Machine Monitor (VMM)



VT Categories

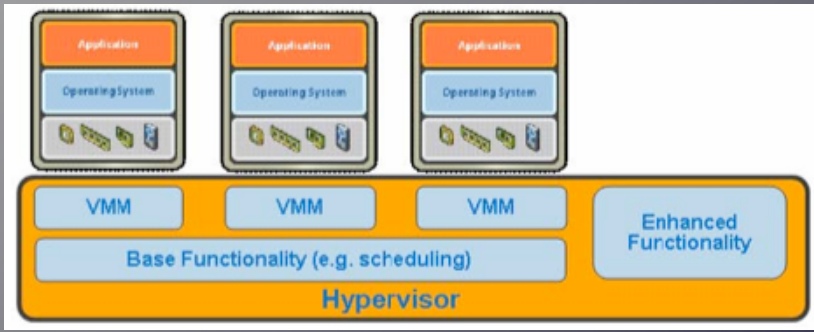


Virtualisation Categories



Hypervisor

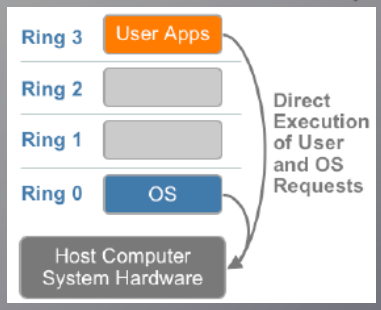
- Manage VMMs
- Create a simulated computer environment for the guest software



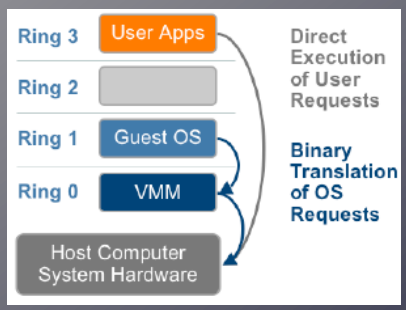
Full Virtualisation

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

Ex: VMWare's, MS Virtual Server



Privilege level architecture

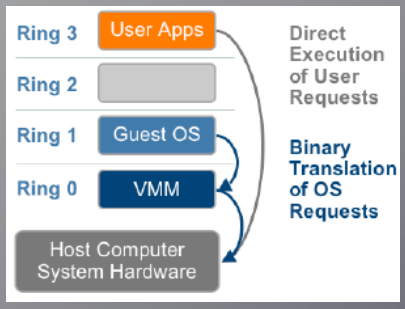


Full virtualisation

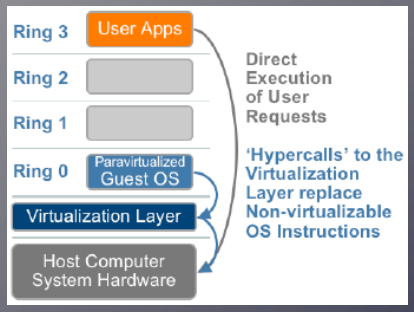
Paravirtualisation

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

Ex: Xen Server



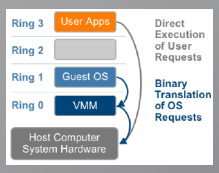
Full virtualisation



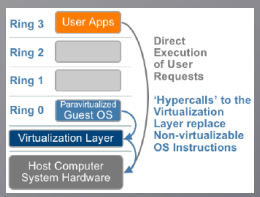
Paravirtualisation

Hardware-Assisted Virtualisation

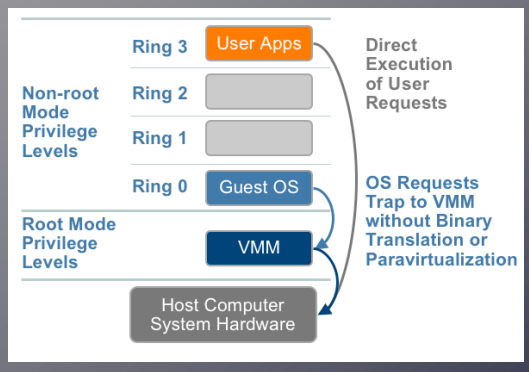
- Technology that allows for a CPU instruction set communication in which the VMM runs in a new root level mode below the OS kernel level. Ex: VT-x, AMD-V



Full virtualisation



Paravirtualisation



Hardware-Assisted Virtualisation

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

Advantages & Disadvantages

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