

# CC - Assignment 1

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## a) Full Virtualization:

- ↳ In full virtualization, the guest OS runs unmodified way. Meaning it does not require any awareness of underlying hardware.
- ↳ Hypervisor manages the VM's and also emulates the hardware for each VM, allowing different OS types to run independently.
- ↳ It provides strong isolation but also has higher overhead due to hardware emulation.
- ↳ It also handles all privileged operations.

eg: VMware, Microsoft Hyper-V.

## b) Para Virtualisation:

- ↳ In para-virtualization, the guest OS is modified to communicate directly with the hypervisor using hypercalls & reducing the need for full hardware emulation.
- ↳ PV is more efficient than full virtualization as it reduces the overhead & improves performance.

eg: Xen, VMware, ESXi

## c) Full VIRTUALISATION ARCHITECTURE

eg: VMware, Microsoft Hyper-V.

The VMware architecture comprises the underlying architecture operating system called the VM Kernel. Processes that run on top of it.

VM Kernel provides means for running all processes on the system, including management applications & services agents.

as well as VM. It has control of all hardware devices on the server & manages resources for their applications.

### i) PARA-VIRTUALIZATION ARCHITECTURE

The basic components of a host-based virtualization environment are the host hypervisor, and the domain, any number of other VMs guests, & tools & commands, & configuration files that let you manage virtualization collectively the physical computer running all these component is called a VM host because together these components form a platform for hosting the VM.

#### MODIFICATIONS IN PARA-VIRTUALIZATION

- ↳ The guest OS kernel is modified to replace sensitive instruction with hypercalls.
- ↳ No need for binary translation for full hardware emulation.
- ↳ Improves efficiency in CPU, memory & I/O management.

The guest OS uses specialised device drivers designed to interact directly with the hypervisor leading to faster I/O operations & reduced latency.

All the memory management, I/O, networking, kernel and user space drivers are modified to support virtualization.

c) WSLx: It adds x86 instruction set - MMU to windows

↳ Acts as a compatibility layer that translates Linux system calls to Windows system calls.

↳ Not a VM or container, it's a translation layer.

WSL 2: (using Hypervisor)

↳ Runs real Linux kernel inside a lightweight virtual machine

↳ Categorized as a VM because it uses a virtualised environment

d) WSL 2 is full virtualization because of the following reasons:

↳ Uses a full Linux kernel in lightweight VM

- WSL2 runs a full Linux kernel inside Hyper-V VM.

- Similar to FV where guest OS runs in its isolated environment.

↳ No Guest OS modification

- Unlike para virtualization, WSL2 runs completely unmodified

- Linux kernel is built and run by host itself.

- Linux kernel is provided by Microsoft but remains standard.

↳ Uses Hardware Assisted Virtualization

- WSL2 relies on Hyper-V's hardware virtualization capabilities like full virtualization.

↳ Separate Virtualized Networking & filesystem

- Networking & filesystem access go through a virtualized interface rather than direct integration with Windows.

- ② Advantages of WSL-2 over Virtual box Sandbox
  - ↳ Environment - tools and filetypes
  - ↳ Performance - faster file I/O operations than Virtual box.
  - ↳ Seamless Integration - tight integration with windows tools. (eg: vs code)
  - ↳ Lightweight - Consumes fewer resources compared to full VM's in Virtual box.
  - ↳ StartUp Time - WSL 2 boots almost instantly compared to virtual box.
  - ↳ Networking - Uses localhost directly for networking.
- ↳ Has the changes made to linux kernel for WSL 2 are publicly available?
- ↳ Microsoft has made its custom WSL 2 kernel open source under the GPL-V2 license.
- ↳ The kernel has been modified to run efficiently on windows using Hyper-V but is open source for developers.

3) WSL 2 - runs UNIX kernel inside a lightweight utility virtual machine managed by windows offer full system performance compared to WSL.

Designed for seamless integration of Linux & windows.

KVM supports both full & para virtualization. KVM is a full virtualization of Linux that provides device abstraction but does not handle processor emulation requiring host to handle guest vm's & firmware.

WSL2 is optimized for Linux running Linux on windows with overhead. KVM is more general purpose virtualization.