SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

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DEPARTMENT OF COMPUTER APPLICATIONS

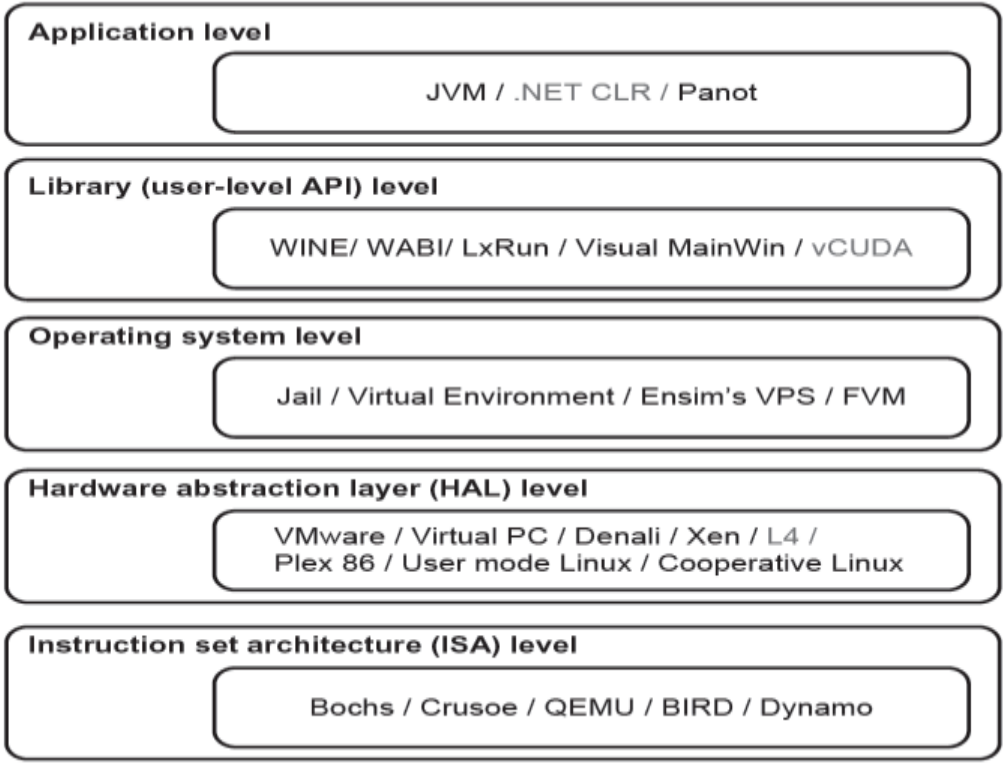
COURSE	UNIT II	TOPIC	Semester
23CAE717 Cloud Computing	Virtualization	Implementation levels of Virtualization	II Semester / I MCA

Implementation level of Virtualization

- Main function of Hypervisor is virtualize the physical hardware of a host machine into virtual resources to be used by the VMs, exclusively

- Virtualization can be implemented at
  - Instruction set architecture (ISA) level
  - Hardware level
  - Operating system level
  - Library support level
  - Application level

Implementation level of Virtualization



Instruction set Architecture (ISA)

Emulating a given ISA by the ISA of the host machine.

- e.g, Binary code can run on an x-86-based host machine with the help of ISA emulation.

Advantage:

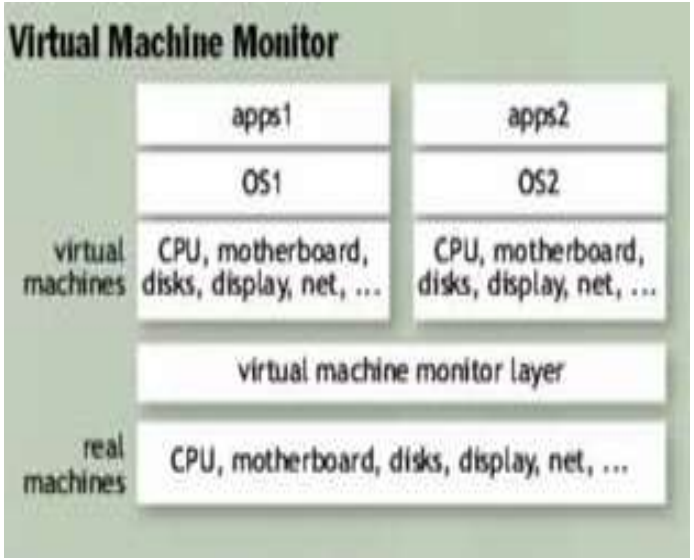
- It can run a large amount of legacy binary codes written for various processors on any given new hardware host machines
- Best application flexibility

Shortcoming & limitation:

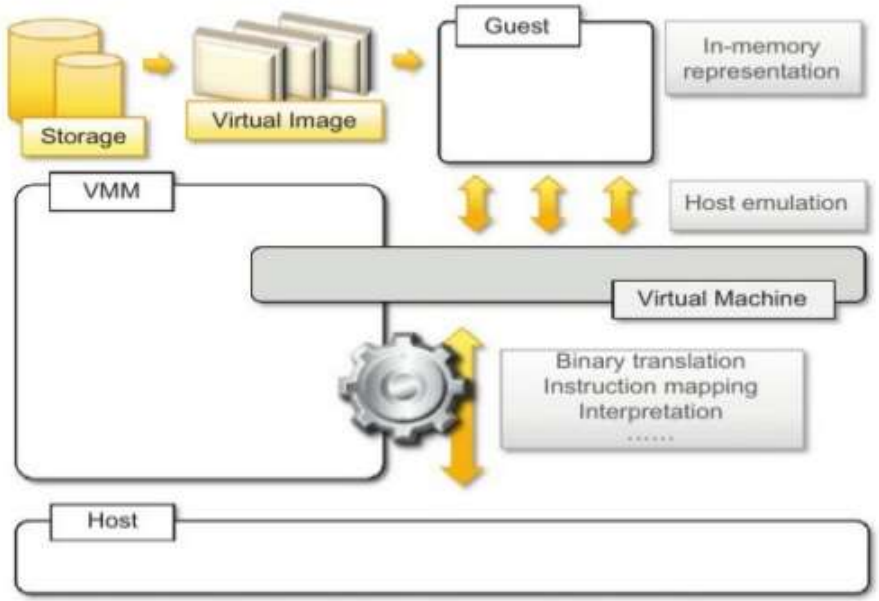
- One source instruction may require tens / hundreds of native target instructions to perform its function, which is relatively slow.
- V-ISA requires adding a processor-specific software translation layer in the complier

Hardware level of Virtualization

- Performed right on top of the bare hardware
- process manages the underlying hardware through virtualization
- idea is to virtualize a computer's resources, such as its **processors, memory, and I/O devices**
- Xen hypervisor used to virtualize x86-based machines to run Linux/other guest OS applications

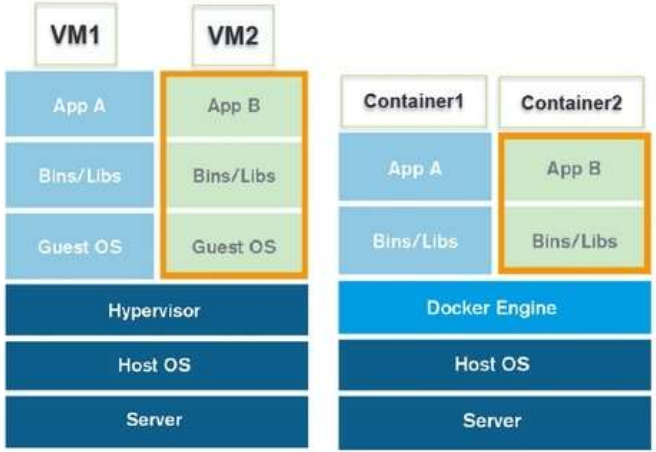


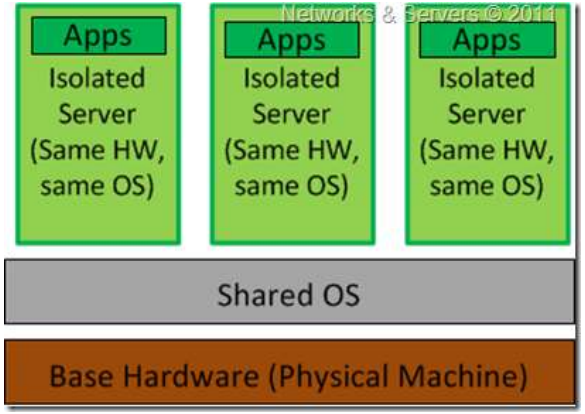
Hardware-level virtualization



OS level of Virtualization

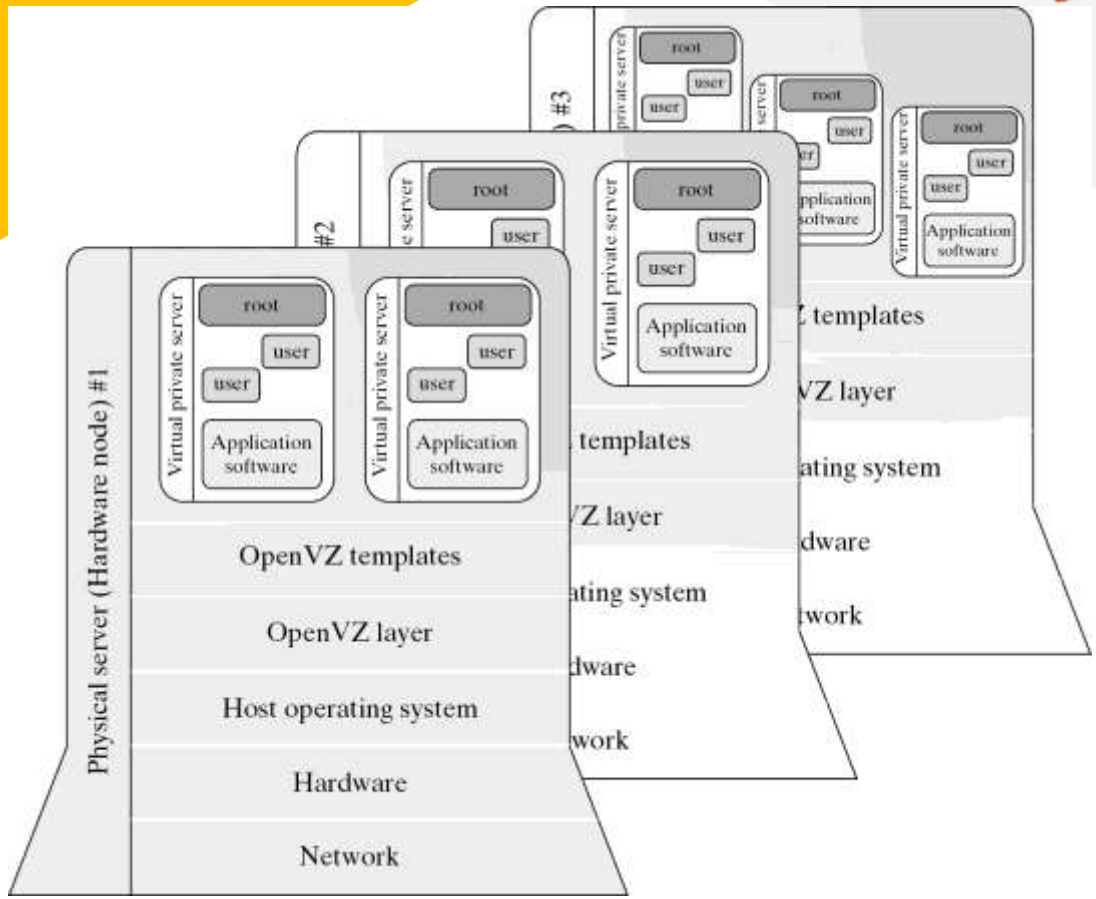
- An abstraction layer between **traditional OS and user applications**
- creates isolated containers on a single physical server and the OS instances to utilize the hardware and software in data centers
- containers behave like real servers





OS level of Virtualization

Virtualization for Linux and Windows NT Platforms



Library level of Virtualization

- Most applications use APIs exported by user-level libraries
- Virtualization with library interfaces is possible by **controlling the communication link between applications and the rest of a system through API** hooks
- WINE for windows applications on Linux/UNIX host

User Application level of Virtualization

- Also known as process-level virtualization
- popular approach is to deploy high level language (HLL) VMs.
- In this scenario, the layer sits as an application program on top of the operating system, and the layer exports an abstraction of a VM that can run programs written and compiled to a particular abstract machine definition
- Example .NET CLR and JVM
- Other forms of application-level virtualization are known as application isolation, application sandboxing, or application streaming.

Comparison

Implementation level	Performance	Impl. Complexity	Application flexibility	Application isolation
ISA	Very poor	Medium	Excellent	Medium
Hardware	Excellent	High	Medium	Very Good
OS	Excellent	Medium	Low	Very Poor
Application	Medium	Low	Low	Very Poor
Library	Poor	High	Low	Excellent

Design Requirements

- VMM should provide an environment for programs which is essentially identical to the original machine
- programs run in this environment should show, at worst, only minor decreases in speed
- a VMM should be in complete control of the system resources

Virtualization Support @ OS Level

- It is slow to initialize a hardware-level VM because each VM creates its own image from scratch and storage of such images are also slow
- OS-level virtualization provides a feasible solution for these hardware-level virtualization issues
- It enables multiple isolated VMs within a single operating system kernel
- Virtual Environment (VE) has its own set of processes, file system, user accounts, network interfaces with IP addresses, routing tables, firewall rules, and other personal settings
- Advantages
  - VMs @ OS level have minimal startup/shutdown costs, low resource requirements, and high Scalability
  - It is possible for a VM and its host environment to synchronize state changes when necessary

References

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