Amirkabir University of Technology
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Cloud Computing

Introduction to virtualization

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Speing 2023

Introduction (cont.)

- ***Virtualization*** is often ***synonymous*** with ***hardware virtualization***.
- Plays a fundamental role in efficiently delivering ***Infrastructure-as-a-Service (IaaS)*** solutions for cloud computing.

https://www.javatpoint.com/infrastructure-as-a-service

Introduction (cont.)

- Virtualization techs have a long trail in the history of computer science.

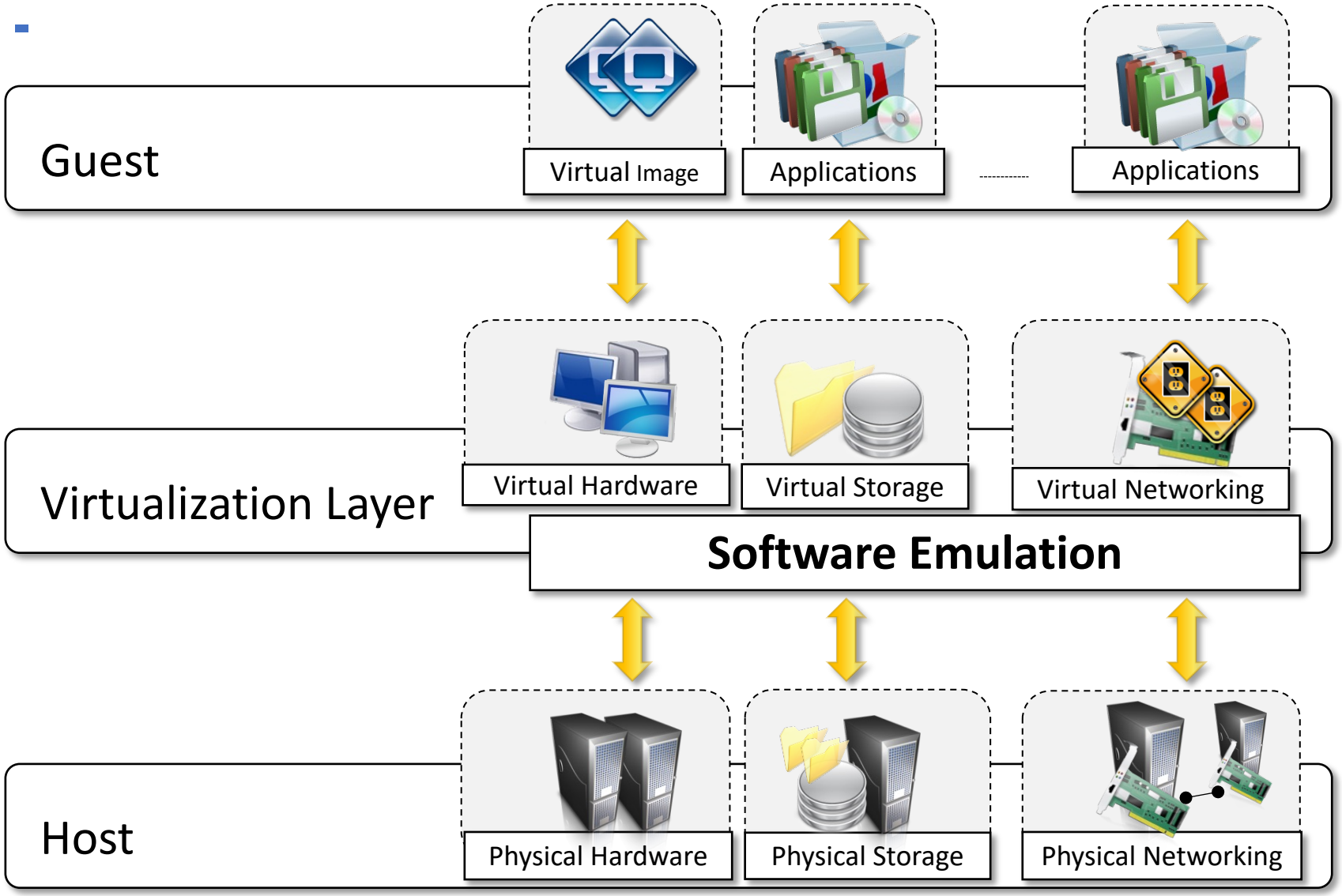
- In many flavors by providing Virtual Environments (VE) at the:
  - Operating system level
  - Programming language level
  - Application level

- Virtualization technologies provide a VE for not only **executing applications** but also for **storage**, **memory**, and **networking**.

Major components of a virtualized environment

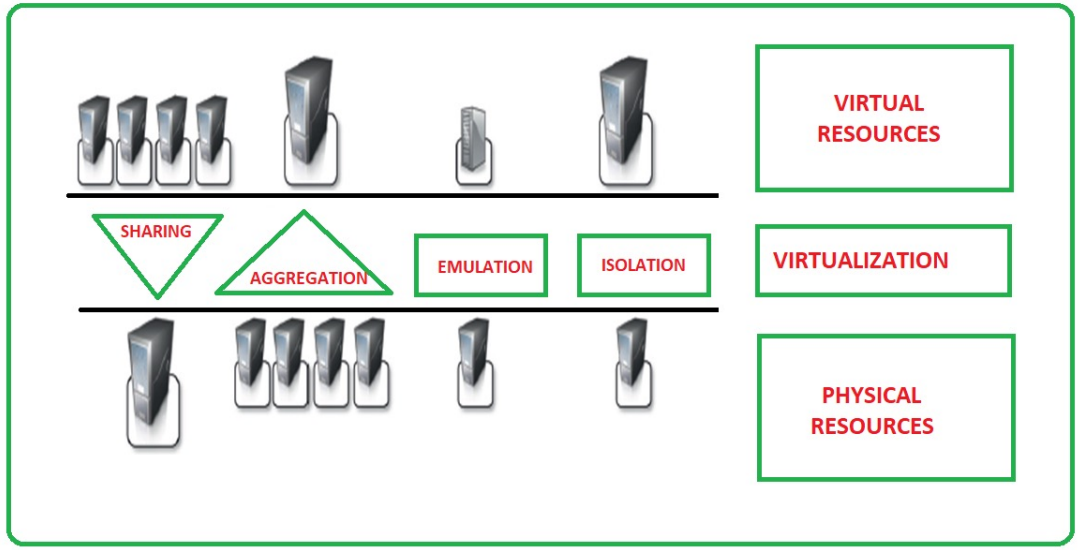
- **Guest**
  - The system component that interacts with the virtualization layer rather than with the host, as would normally happen.
- **Host**
  - The original env. where the guest is supposed to be managed.
- **Virtualization layer**
  - Recreate the same or a different env. where the guest will operate.

Major components of a virtualized environment (cont.)



Advantages

- Increased Security
- Managed Execution
  - Sharing
  - Aggregation
  - Emulation
  - Isolation
  - Performance tuning
  - Virtual machine migration
- Portability

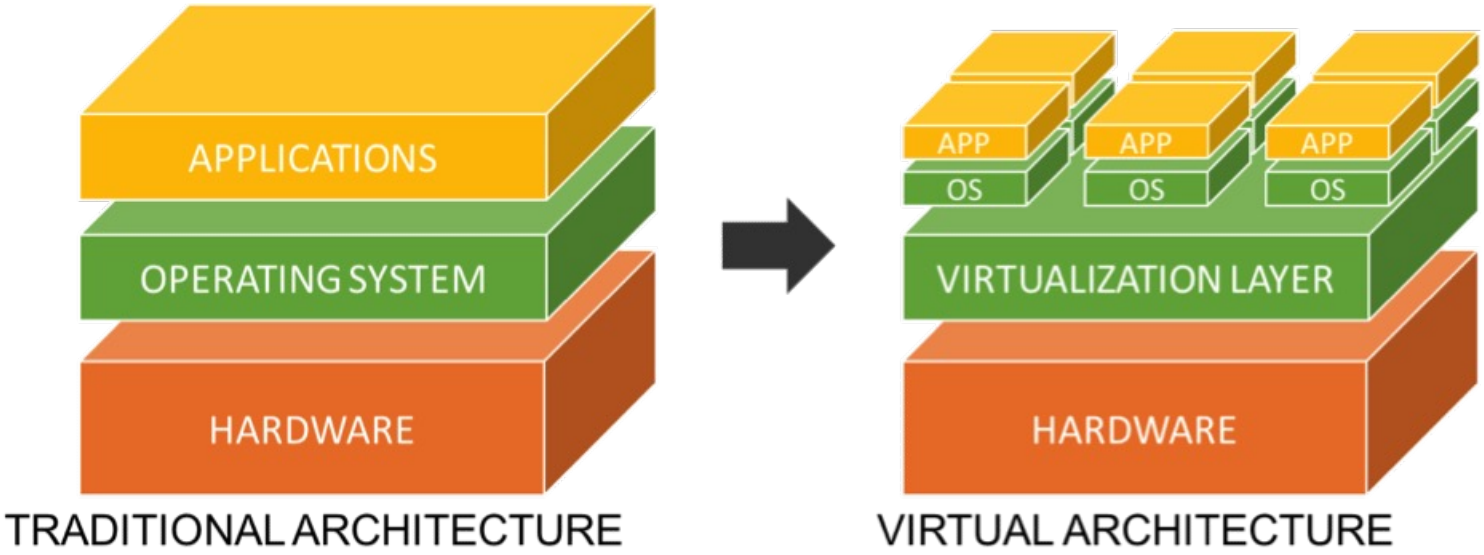


https://www.geeksforgeeks.org/characteristics-of-virtualization/

Advantages

Increased Security

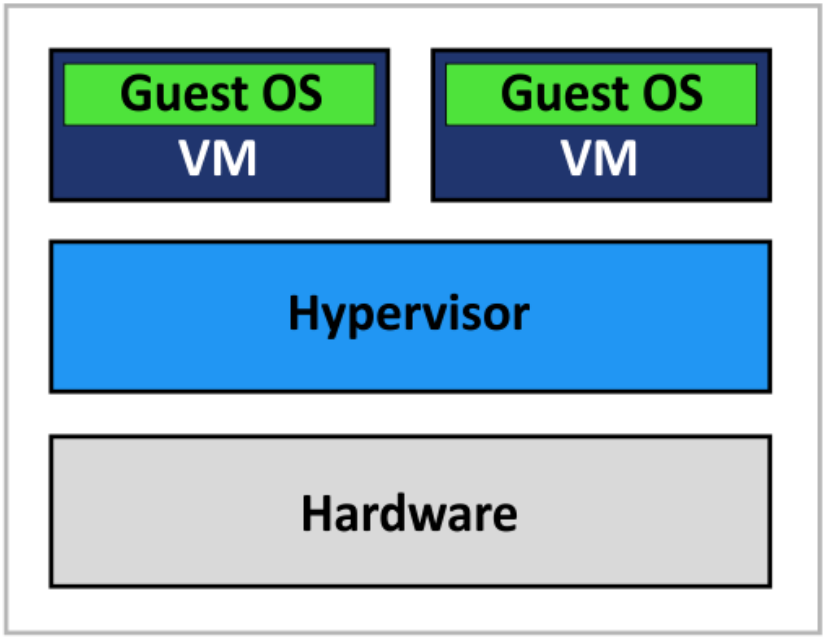
- The ability to control the execution of a guest in a ***completely transparent manner*** opens new possibilities for delivering a secure, controlled execution environment.



Advantages

Increased Security (cont.)

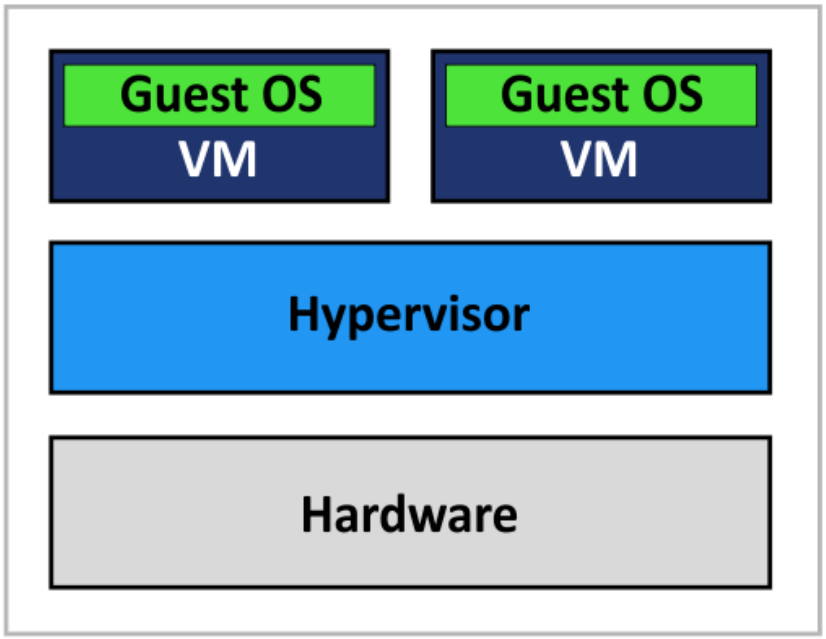
- All the operations of the guest are generally ***performed against the Virtual Machine (VM)***, which then translates and applies them to the host.



Advantages

Increased Security (cont.)

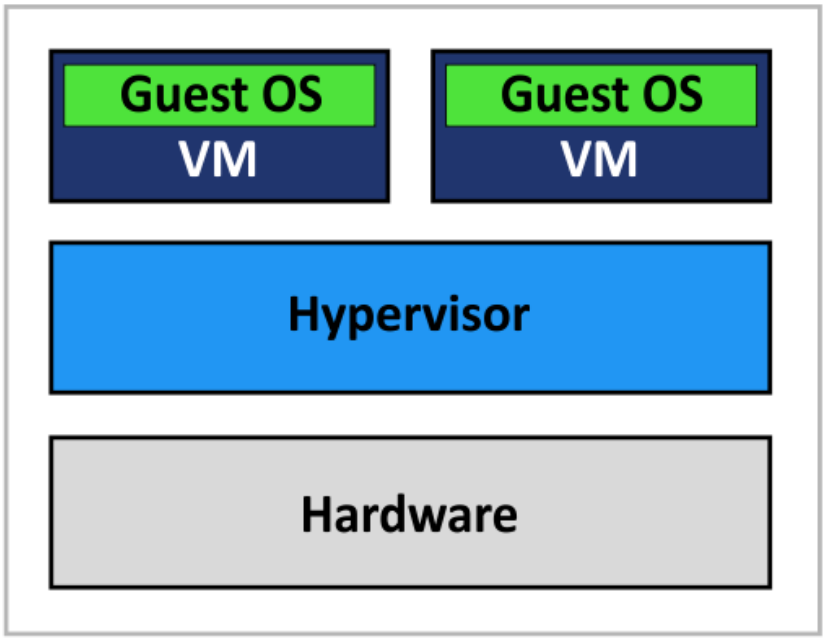
- This level of ***indirection*** allows the hypervisor (VM manager) ***to control and filter the activity of the guest***, thus preventing **some harmful** operations from being performed.



Advantages

Increased Security (cont.)

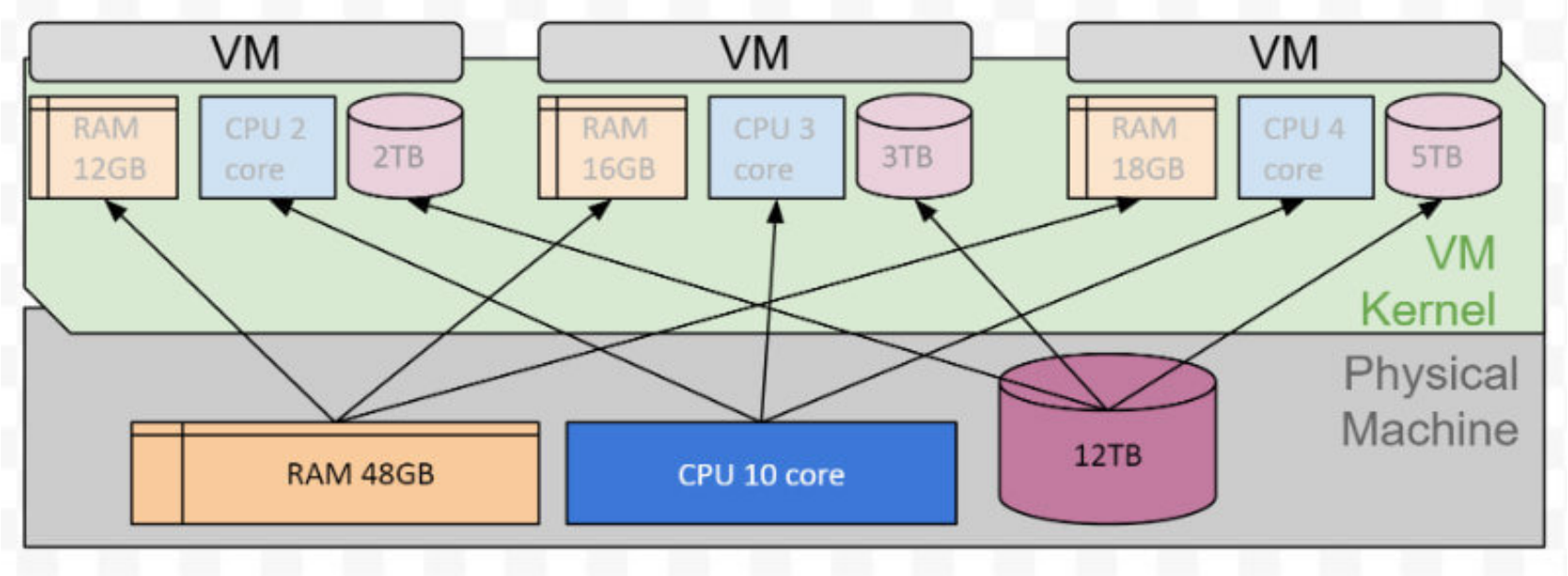
- Resources exposed by the ***host*** can then be ***hidden or simply protected from the guest.***



Advantages

Managed Execution: **Sharing**

- Virtualization allows the creation of a ***separate computing environments*** within the same host.

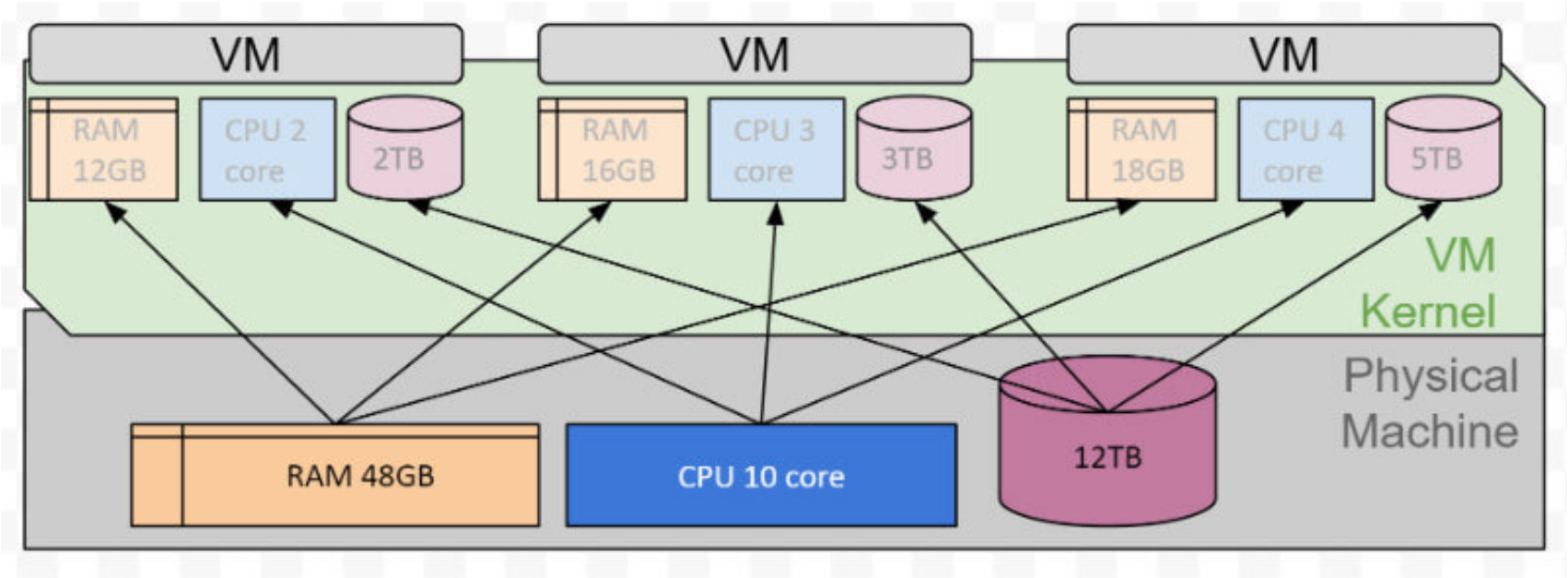


https://actusdigital.com/2018/01/08/virtual-machine-or-physical-server/

Advantages

Managed Execution: **Sharing** (cont.)

- In this way it is possible to ***fully exploit the capabilities*** of a ***powerful*** host, ***which would otherwise be underutilized***.

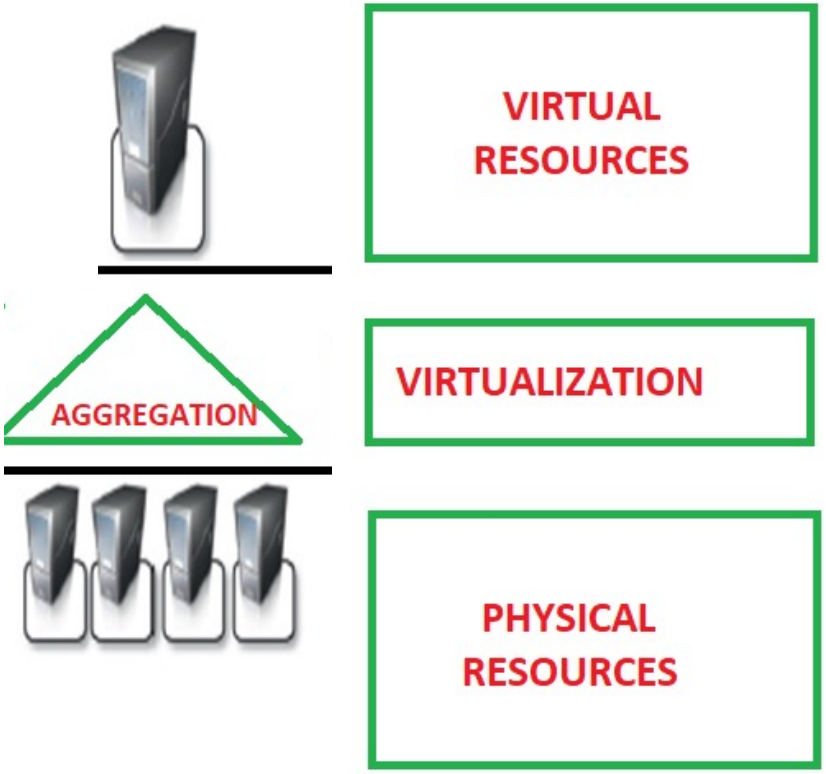


https://actusdigital.com/2018/01/08/virtual-machine-or-physical-server/

Advantages

Managed Execution: Aggregation

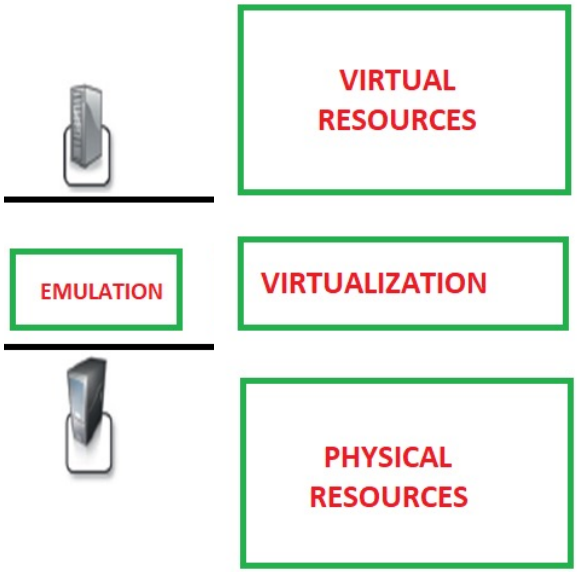
- A ***group*** of ***separate hosts*** can be tied together and represented to guests as a single virtual host.



Advantages

Managed Execution: Emulation

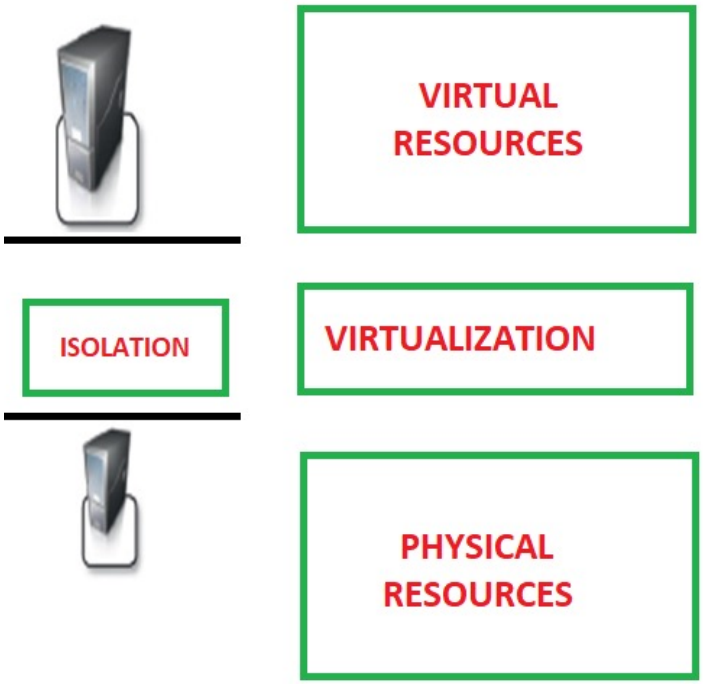
- A completely ***different environment with respect to the host can be emulated***.
- Allowing the execution of guest programs ***requiring specific characteristics*** that are ***not present*** in the physical host.



Advantages

Managed Execution: Isolation

- Virtualization allows providing guests—whether they are operating systems, applications, or other entities—with a **completely separate environment**, in which **they are executed**.



Advantages

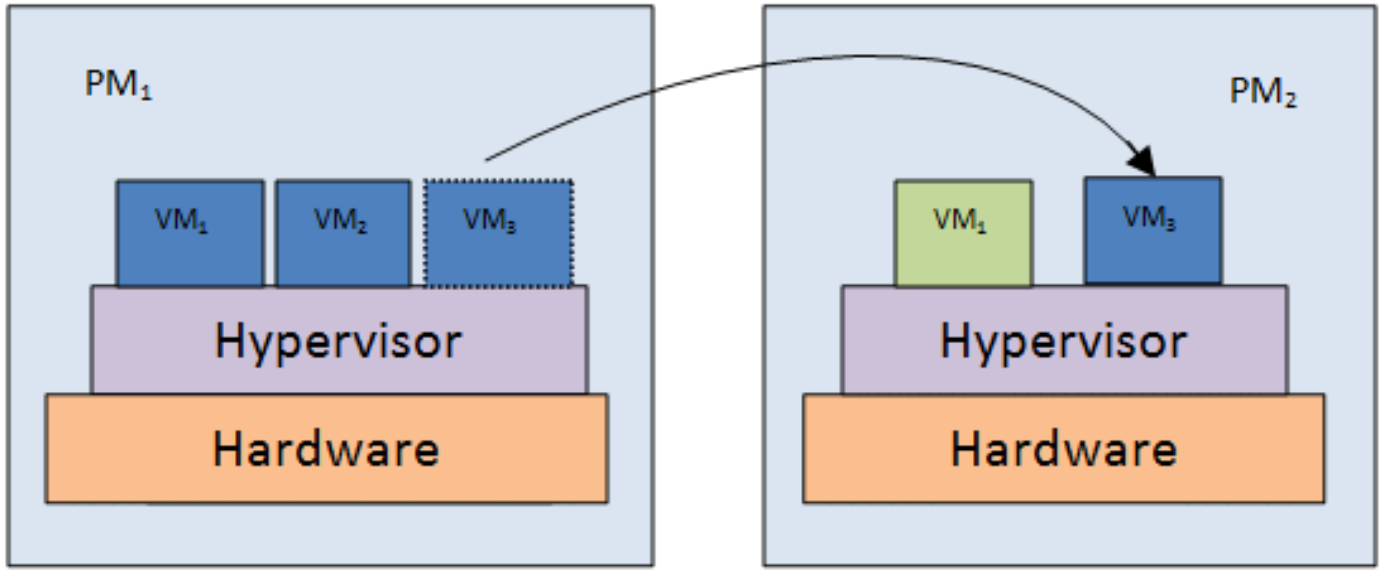
Managed Execution: Performance tuning

- It becomes easier to control the performance of the guest by finely ***tuning*** the properties of the ***resources exposed*** through the virtual environment.

- This capability provides a means to e***ffectively implement a quality-of-service (QoS)*** infrastructure that more easily fulfills the service-level agreement ***(SLA) established for the guest***.

Managed Execution: Virtual machine migration

- Managed execution allows VM managers to stop the execution of a guest operating system, move its virtual image into another VM, and resume its execution in **a completely transparent manner**.



Managed Execution: Virtual machine migration

- Managed execution allows easy capturing of the state of the guest program, persisting it, and resuming its execution.

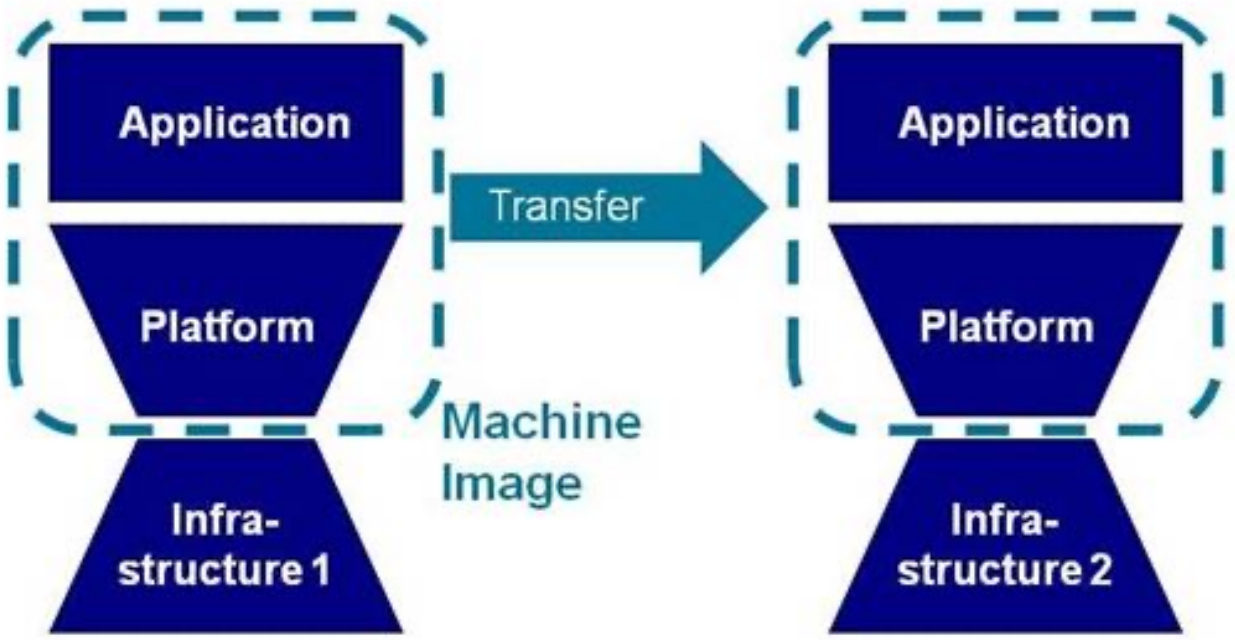
- This allows VM managers to stop the execution of a guest operating system, move its virtual image into another VM, and resume its execution in **a completely transparent manner**.

- **This is an important feature in virtualized data centers for optimizing their efficiency in serving application demands**.

Advantages

Portability of a hardware virtualization solution

- Guest is packaged into a ***virtual image*** that, in most cases, can be safely moved and executed on top of different ***virtual machines.***

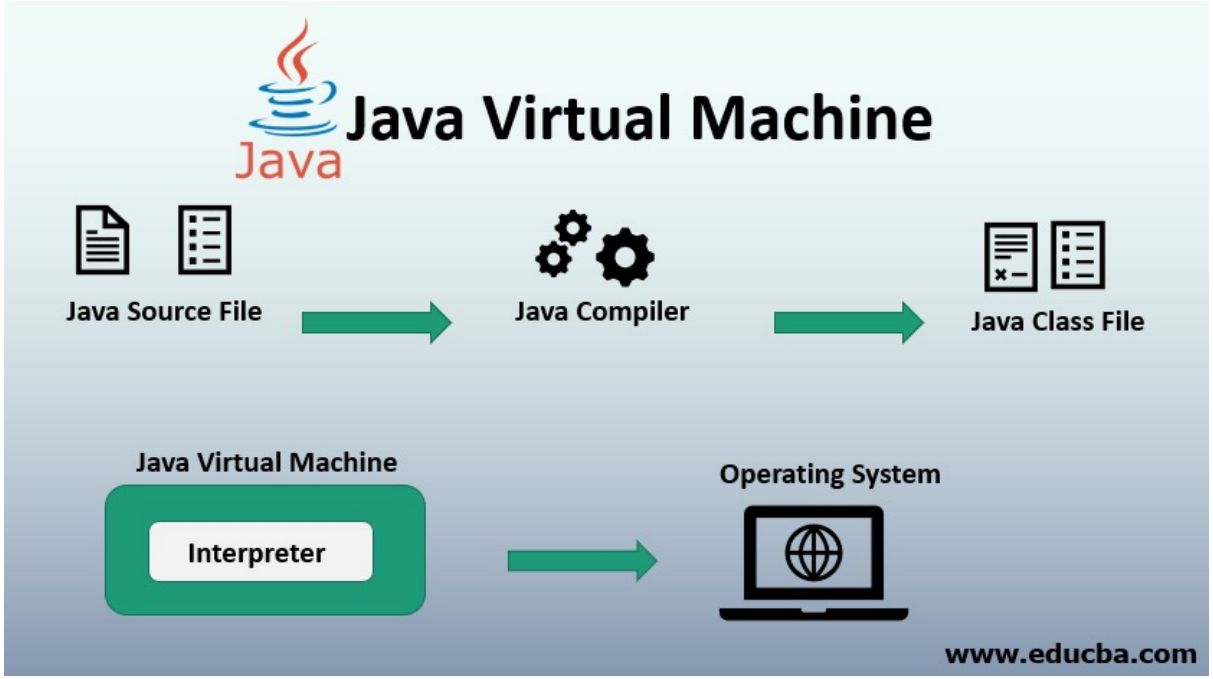


http://www.opengroup.org/cloud/cloud_iop/p4.htm

Advantages

Portability of programming-level virtualization

- The binary code representing application components (jars or assemblies) can be run ***without any recompilation on any implementation of the corresponding virtual machine.***



https://www.educba.com/java-virtual-machine/