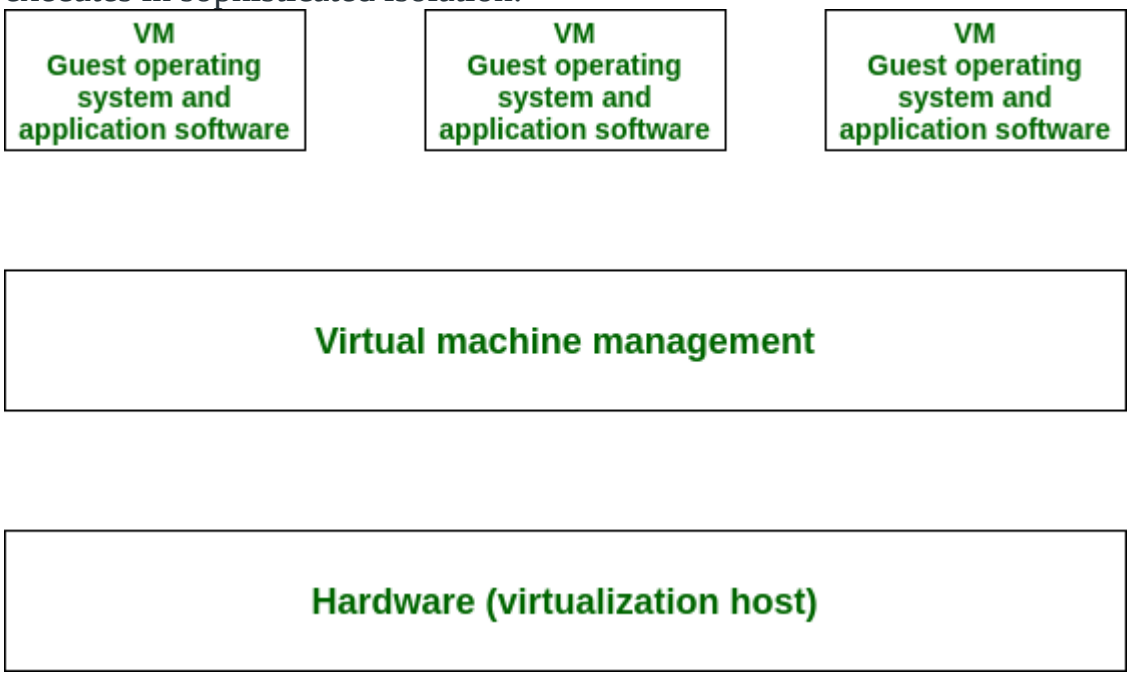
Hardware Based Virtualization

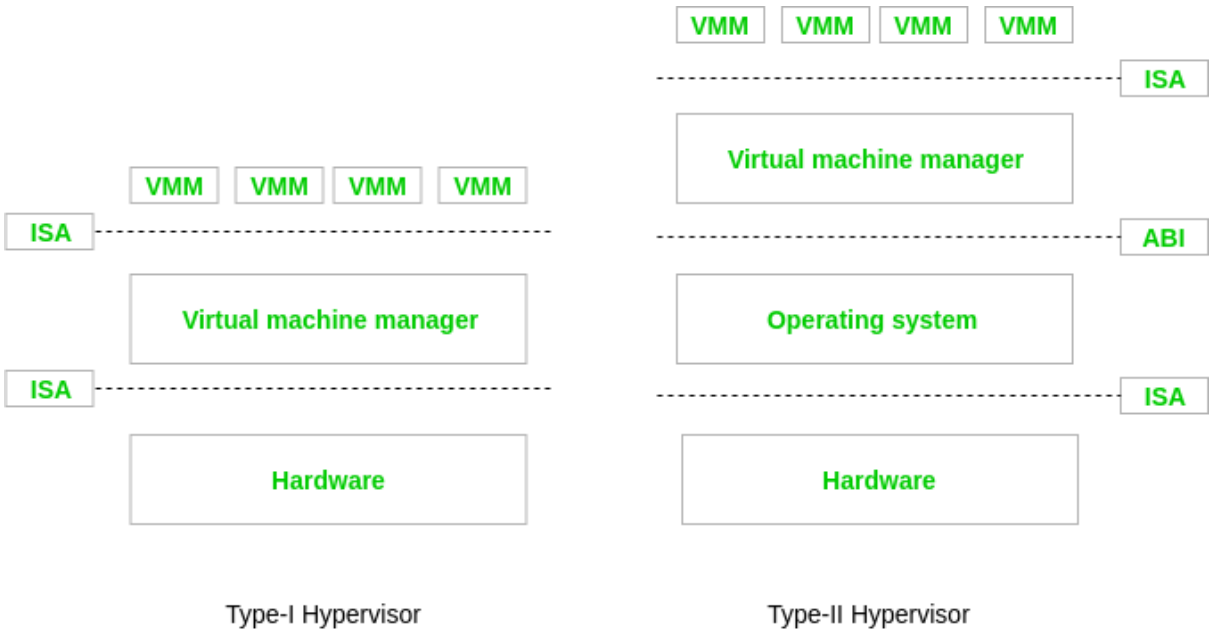
- Prerequisite – Virtualization In Cloud Computing and Types, Types of Server Virtualization, Hypervisor
A platform virtualization approach that allows efficient full virtualization with the help of hardware capabilities, primarily from the host processor is referred to as Hardware based virtualization in computing. To simulate a complete hardware environment, or virtual machine, full virtualization is used in which an unchanged guest operating system (using the common instruction set as the host machine) executes in sophisticated isolation.



The different logical layers of operating system-based virtualization, in which the VM is first installed into a full host operating system and subsequently used to generate virtual machines.

An abstract execution environment in terms of computer hardware in which guest OS can be run, referred to as Hardware-level virtualization. In this, an operating system represents the guest, the physical computer hardware represents a host, its emulation represents a virtual machine, and the hypervisor represents the Virtual Machine Manager. When the virtual machines are allowed to interact with hardware without any intermediary action requirement from the host operating system generally makes hardware-based virtualization more efficient. A fundamental component of hardware virtualization is the hypervisor, or virtual machine manager (VMM).

Basically, there are two types of Hypervisors which are described below:



Type-I Hypervisor Type-II Hypervisor

- **Type-I hypervisors:** Hypervisors of type I run directly on top of the hardware. As a result, they stand in for operating systems and communicate directly with the ISA interface offered by the underlying hardware, which they replicate to allow guest operating systems to be managed. Because it runs natively on hardware, this sort of hypervisor is also known as a native virtual machine.
- **Type-II hypervisors:** To deliver virtualization services, Type II hypervisors require the assistance of an operating system. This means they're operating system-managed applications that communicate with it via the ABI and simulate the ISA of virtual hardware for guest operating systems. Because it is housed within an operating system, this form of hypervisor is also known as a hosted virtual machine.

A hypervisor has a simple user interface that needs some storage space. It exists as a thin layer of software and to establish a virtualization management layer, it does hardware management function. For the provisioning of virtual machines, device drivers and support software are optimized while many standard operating system functions are not implemented. Essentially, to enhance performance overhead inherent to the coordination which allows multiple VMs to interact with the same hardware platform this type of virtualization system is used.

Hardware compatibility is another challenge for hardware-based virtualization. The virtualization layer interacts directly with the host hardware, which results that all the associated drivers and support software must be compatible with the hypervisor. As hardware devices drivers available to other operating systems may not be available to hypervisor platforms similarly. Moreover, host management and administration features may not contain the range of advanced functions that are common to the operating systems.

Note: Hyper-V communicates with the underlying hardware mostly through vendor-supplied drivers.

features of hardware-based virtualization are:

Isolation: Hardware-based virtualization provides strong isolation between virtual machines, which means that any problems in one virtual machine will not affect other virtual machines running on the same physical host.
Security: Hardware-based virtualization provides a high level of security as each virtual machine is isolated from the host operating system and other virtual machines, making it difficult for malicious code to spread from one virtual machine to another.
Performance: Hardware-based virtualization provides good performance as the hypervisor has direct access to the physical hardware, which means that virtual machines can achieve close to native performance.
Resource allocation: Hardware-based virtualization allows for flexible allocation of hardware resources such as CPU, memory, and I/O bandwidth to virtual machines.
Snapshot and migration: Hardware-based virtualization allows for the creation of snapshots, which can be used for backup and recovery purposes. It also allows for live migration of virtual machines between physical hosts, which can be used for load balancing and other purposes.
Support for multiple operating systems: Hardware-based virtualization supports multiple operating systems, which allows for the consolidation of workloads onto fewer physical machines, reducing hardware and maintenance costs.
Compatibility: Hardware-based virtualization is compatible with most modern operating systems, making it easy to integrate into existing IT infrastructure.
Advantages of hardware-based virtualization –
It reduces the maintenance overhead of paravirtualization as it reduces (ideally, eliminates) the modification in the guest operating system. It is also significantly convenient to attain enhanced performance. A practical benefit of hardware-based virtualization has been mentioned by VMware engineers and Virtual Iron.
Disadvantages of hardware-based virtualization –
Hardware-based virtualization requires explicit support in the host CPU, which may not available on all x86/x86_64 processors. A “pure” hardware-based virtualization approach, including the entire unmodified guest operating system, involves many VM traps, and thus a rapid increase in CPU overhead occurs which limits the scalability and efficiency of server consolidation. This performance hit can be mitigated by the use of para-virtualized drivers; the combination has been called “hybrid virtualization”.