ECAP470: Cloud Computing

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Learning Outcomes

After this lecture, you will be able to,

✓ learn about hypervisors and their types

✓ explore different hypervisors such as: HLL VM: Xen, KVM, VMware, VirtualBox, Hyper-V
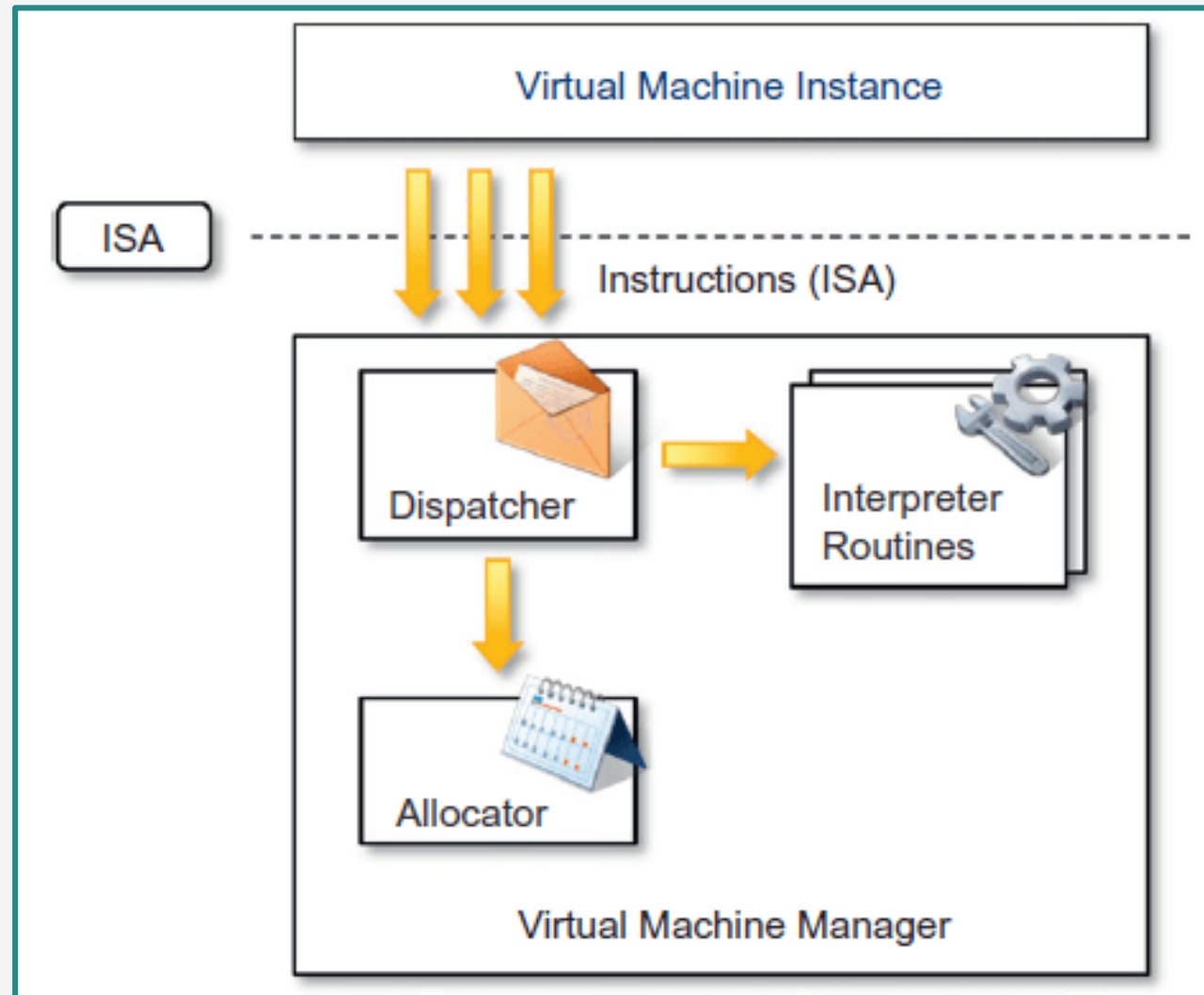
Hypervisors

- VMs are widely used instead of physical machines in the IT industry today.

- Virtual environment can be created with the help of a software tool called hypervisors.

- Hypervisors are also called Virtual Machine Manager (VMM).

Hypervisors

- Key drivers in enabling virtualization in cloud data centers.

- Virtual infrastructure means virtual CPUs (vCPUs), virtual memory, virtual NICs (vNICs), virtual storage, and virtual I/O devices.

Hypervisors

Internal

Organization

of a VMM

Hypervisors

- Three main modules, dispatcher, allocator, and interpreter, coordinate their activity in order to emulate the underlying hardware.
  - Dispatcher
  - Allocator
  - Interpreter Module

Hypervisors

- Design and architecture of a VMM, together with the underlying hardware design of the host machine, determine the full realization of hardware virtualization, where a guest OS can be transparently executed on top of a VMM as though it were run on the underlying hardware.

Hypervisors

The criteria that need to be met by a VMM to efficiently support virtualization were established by Goldberg and Popekin 1974.

Three properties have to be satisfied:

- Equivalence

- Resource control

- Efficiency

Types of Hypervisors

Hypervisors

- **Before the hypervisors are introduced**
- After the hypervisors are introduced

Types of Hypervisors

Hypervisors

- Before the hypervisors are introduced

- After the hypervisors are introduced

Types of Hypervisors

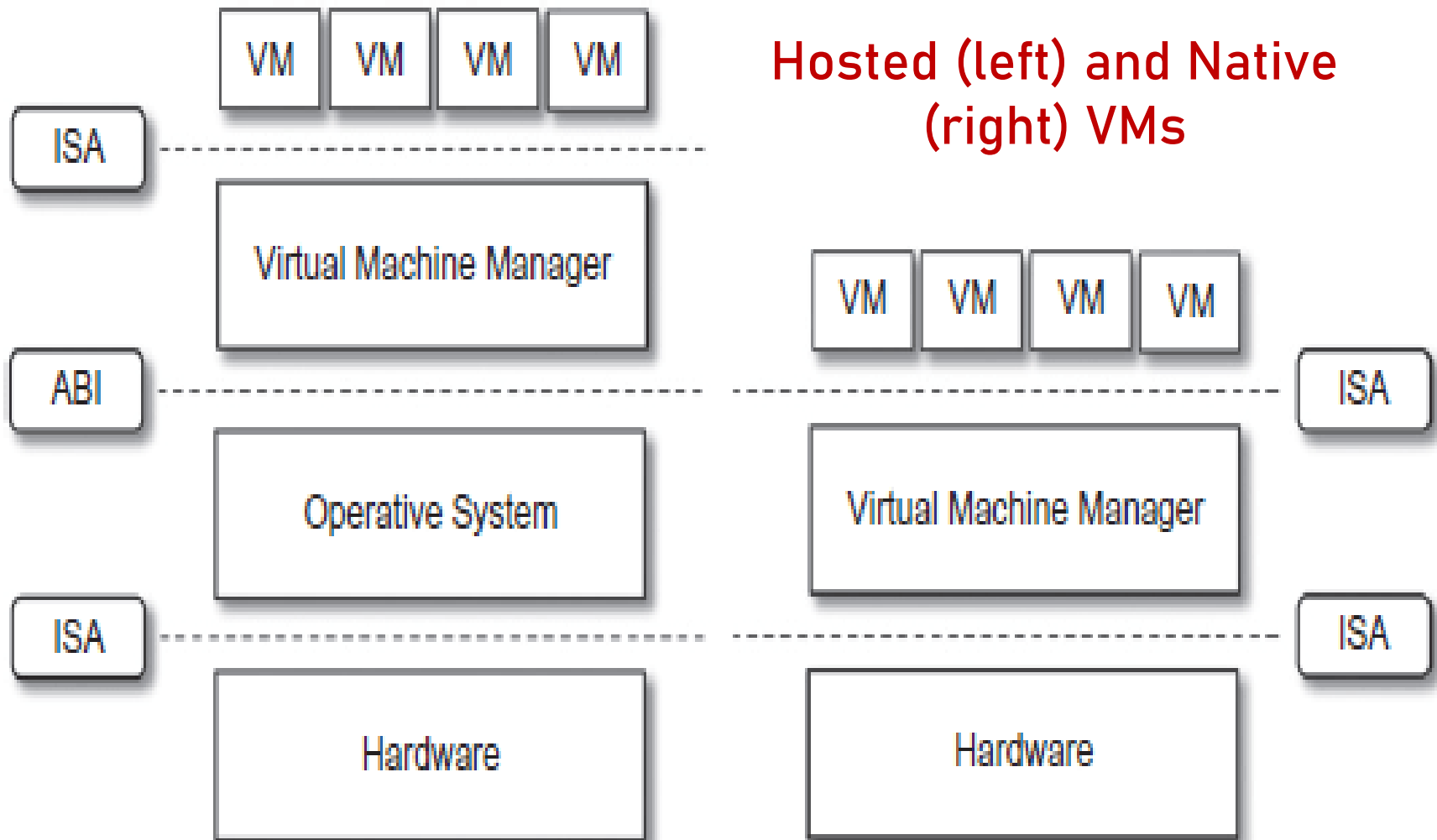Hypervisors are generally classified into two categories:

1. Type 1 or bare metal hypervisors

Types of Hypervisors
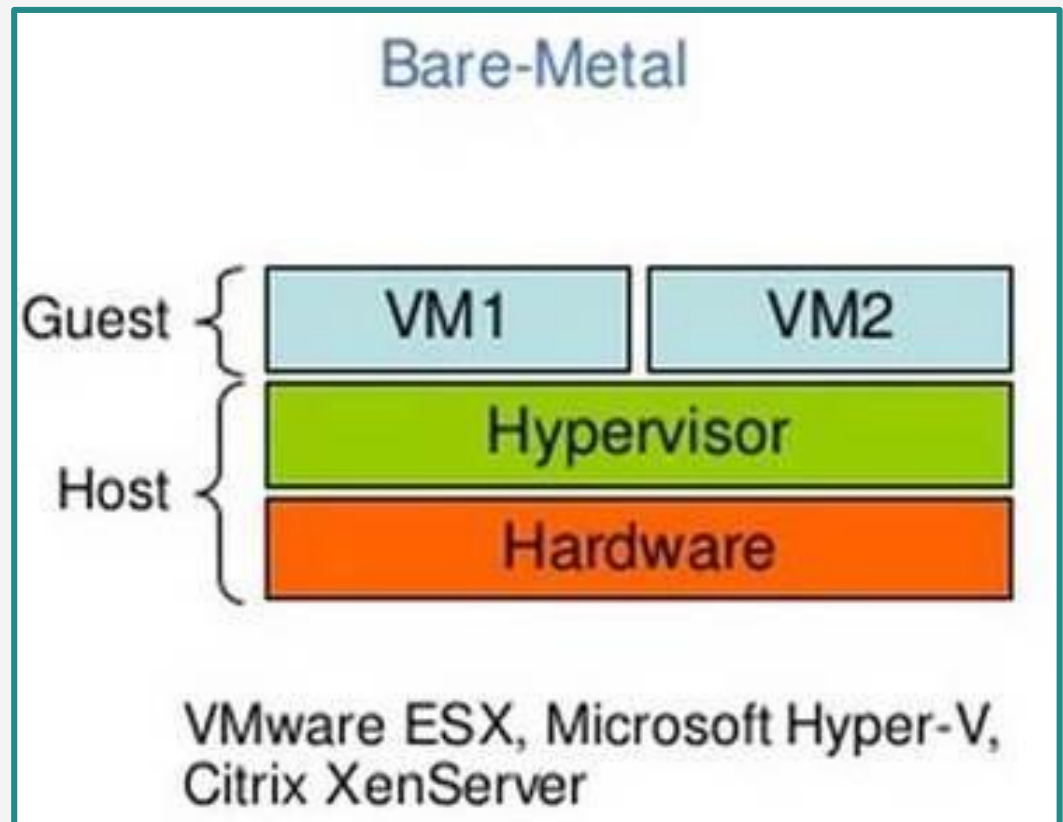
Hypervisors are generally classified into two categories:

1. Type 1 or bare metal hypervisors

2. Type 2 or hosted hypervisors
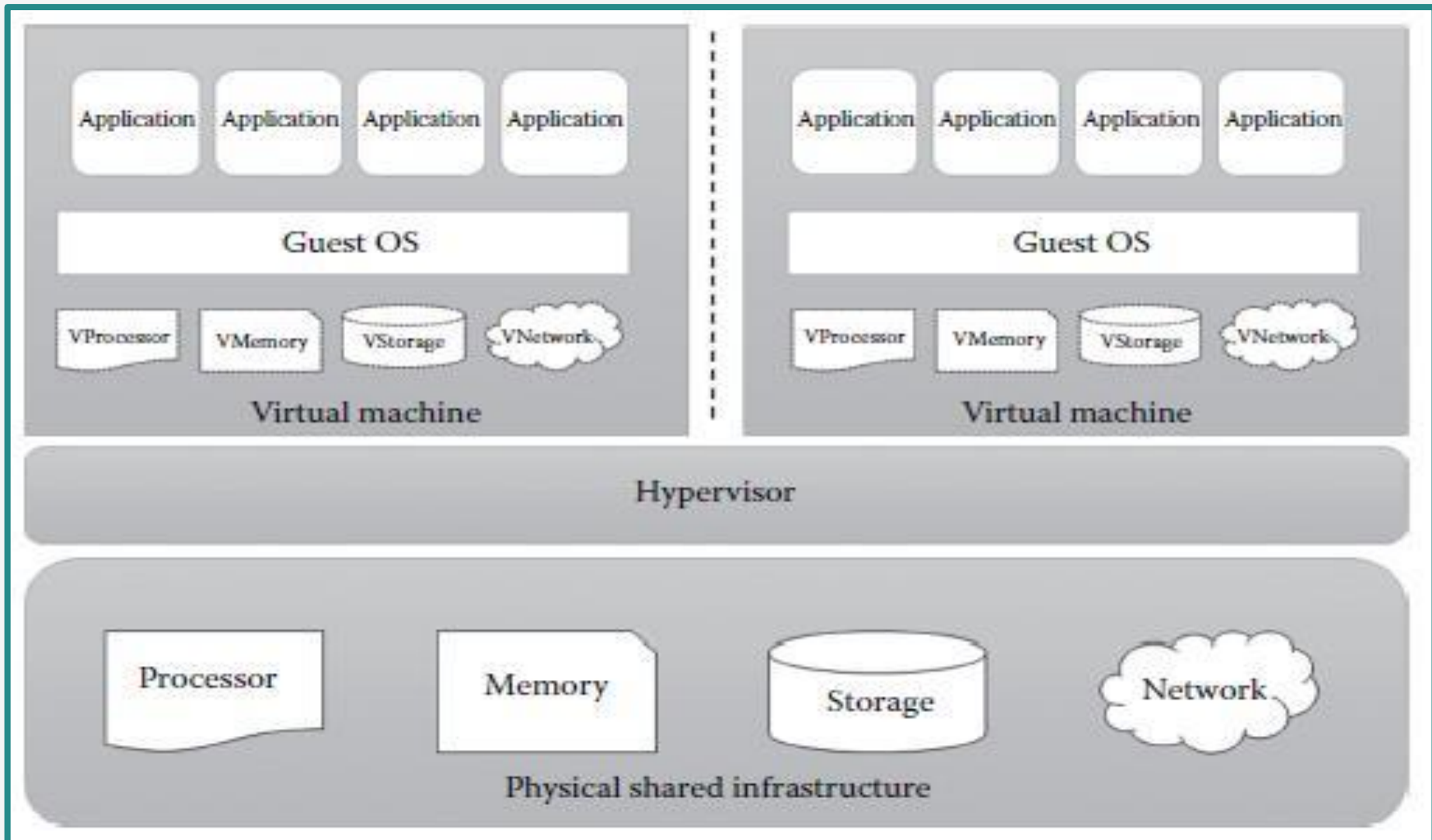
Types of Hypervisors

Hosted (left) and Native (right) VMs

Hypervisors– Type I

- Type I Hypervisors run directly on top of the hardware.

- Also called a native VM since it runs natively on the hardware.

Bare-Metal

Guest { VM1 | VM2

Host { Hypervisor

Hardware

VMware ESX, Microsoft Hyper-V, Citrix XenServer

Hypervisors– Type I

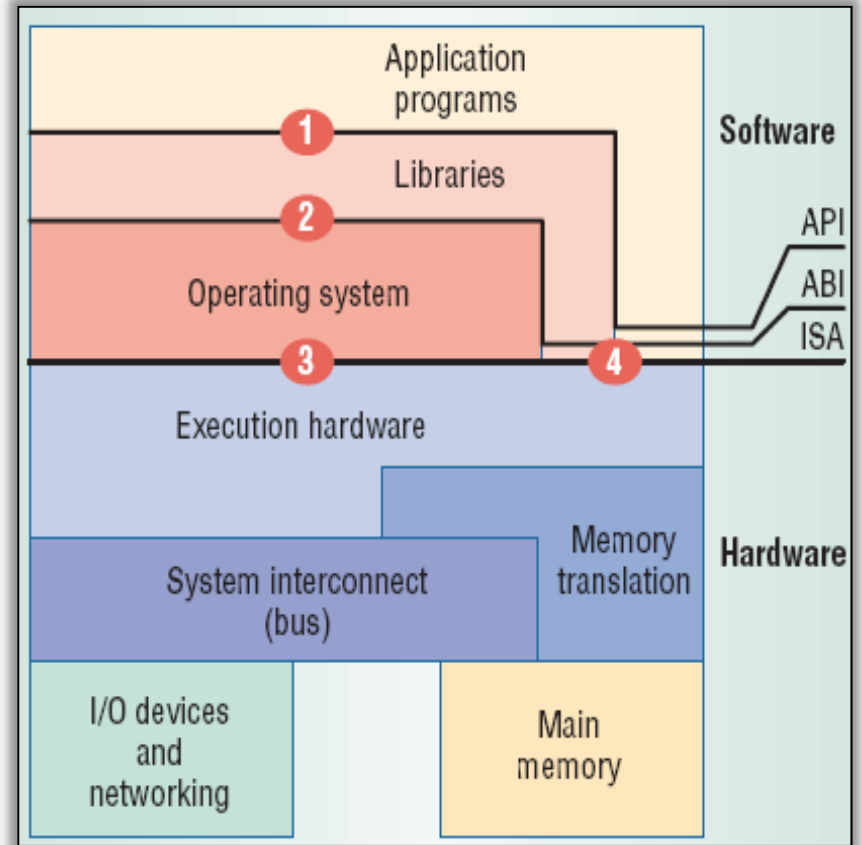# Hypervisors– Type II

- Type II Hypervisors require the support of an operating system to provide virtualization services.

- Also called a hosted or embedded VM since it is hosted within an OS.
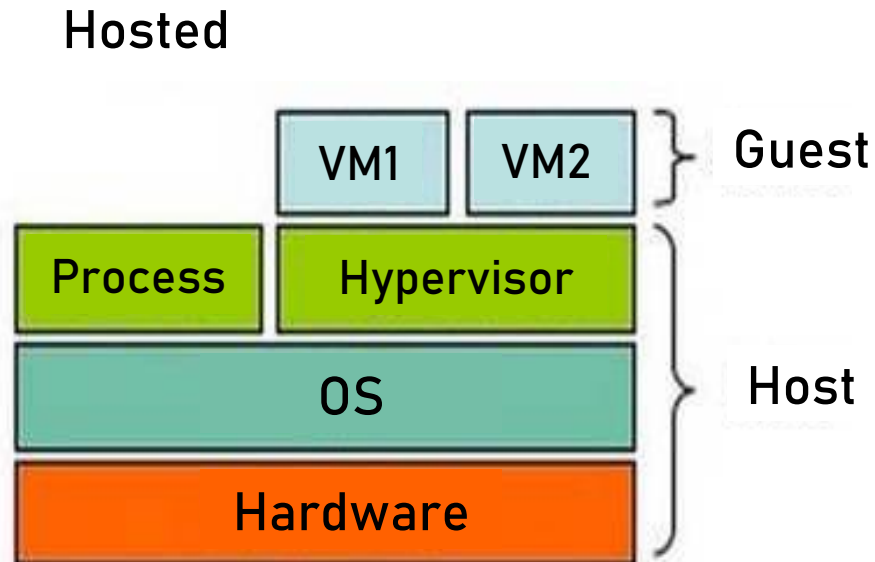
Hypervisors– Type II

Virtualization can take place at these junctures.

- ISA – Instruction Set Architecture
- ABI – Application Binary Interface
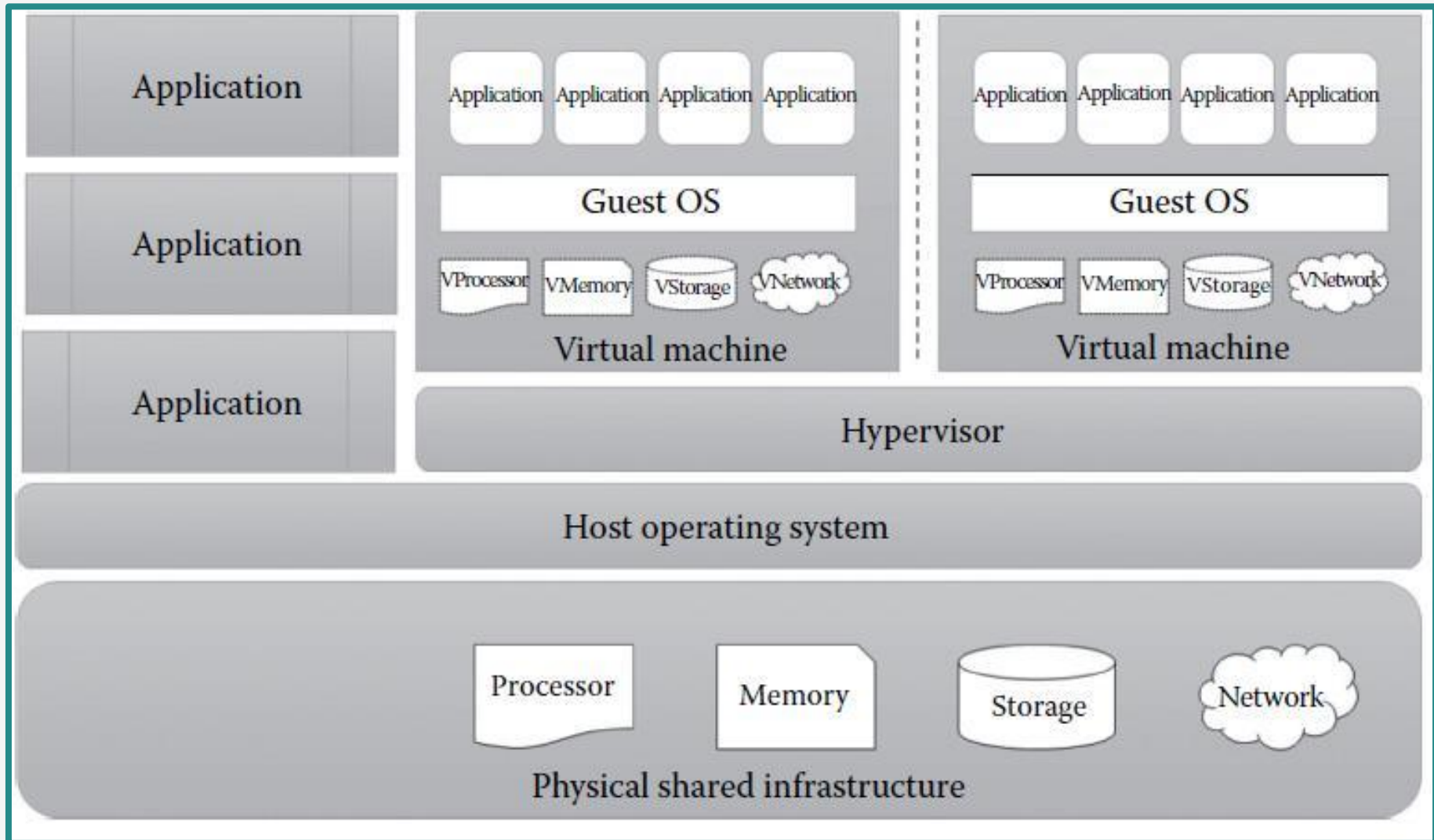- API – Application Programming Interface

Hypervisors– Type II

Hosted

VM1 VM2 } Guest

Process Hypervisor

OS } Host

Hardware

VMware Workstation, Microsoft Virtual PC, Sun VirtualBox, QEMU, KVM

Hypervisors- Type II

Summarized Implementation of Hypervisors

Vary greatly, with options including:

- Type 0 Hypervisors

- Type 1 Hypervisors

- Type 1 Hypervisors

- Type 2 Hypervisors

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- Type 2 Hypervisors

Other Variations Include:

Much variation exists due to breadth, depth and importance of virtualization in modern computing.

- Para Virtualization.

- Programming-environment Virtualization.

- Emulators.

- Application Containment.

Xen

- An **open-source initiative** implementing a virtualization platform based on paravirtualization.

- Xen is a VMM for IA-32 (x86, x86-64), IA-64 and PowerPC 970 architectures.

- **Allows several guest OSs to be executed on the same computer hardware concurrently.**
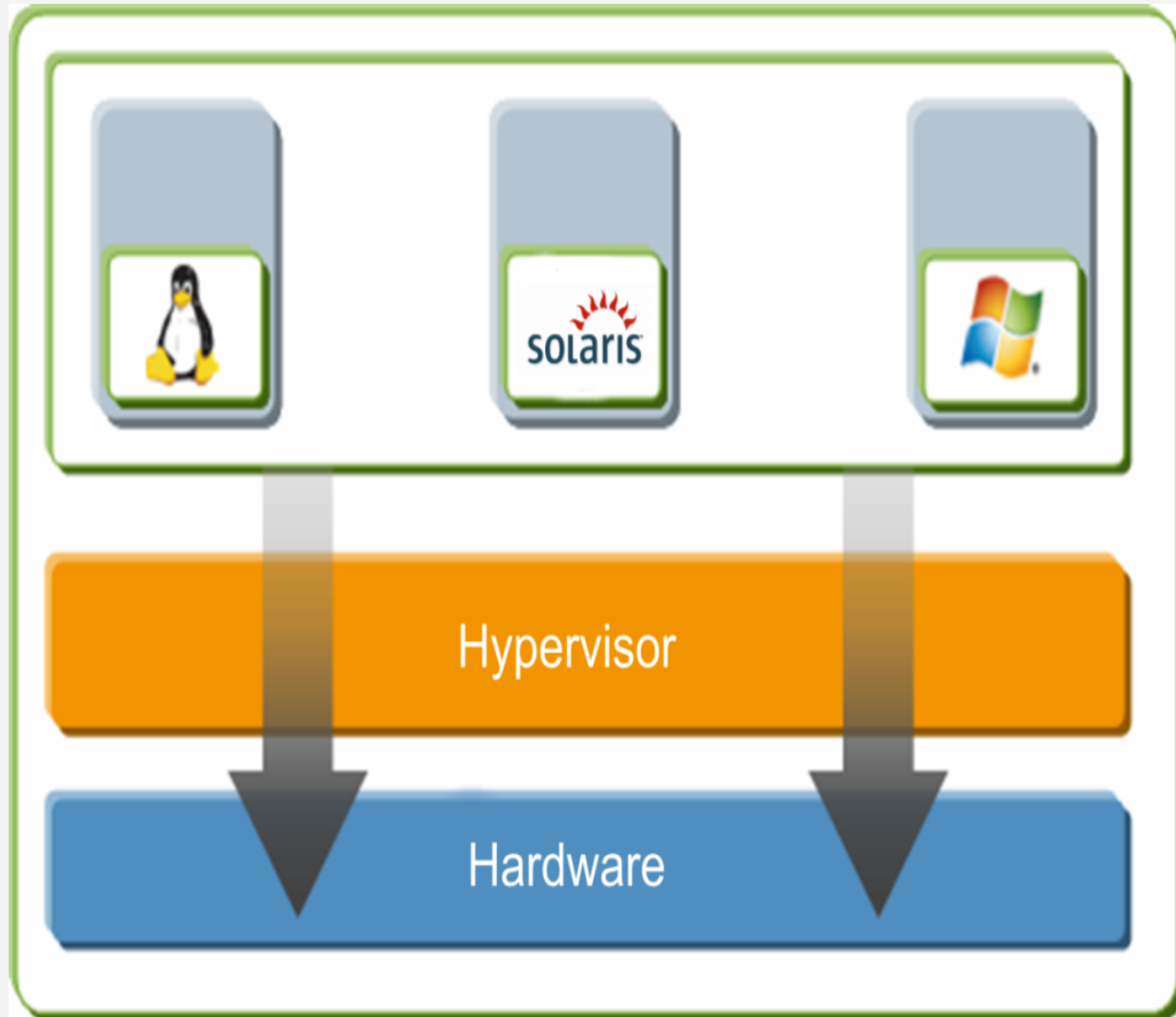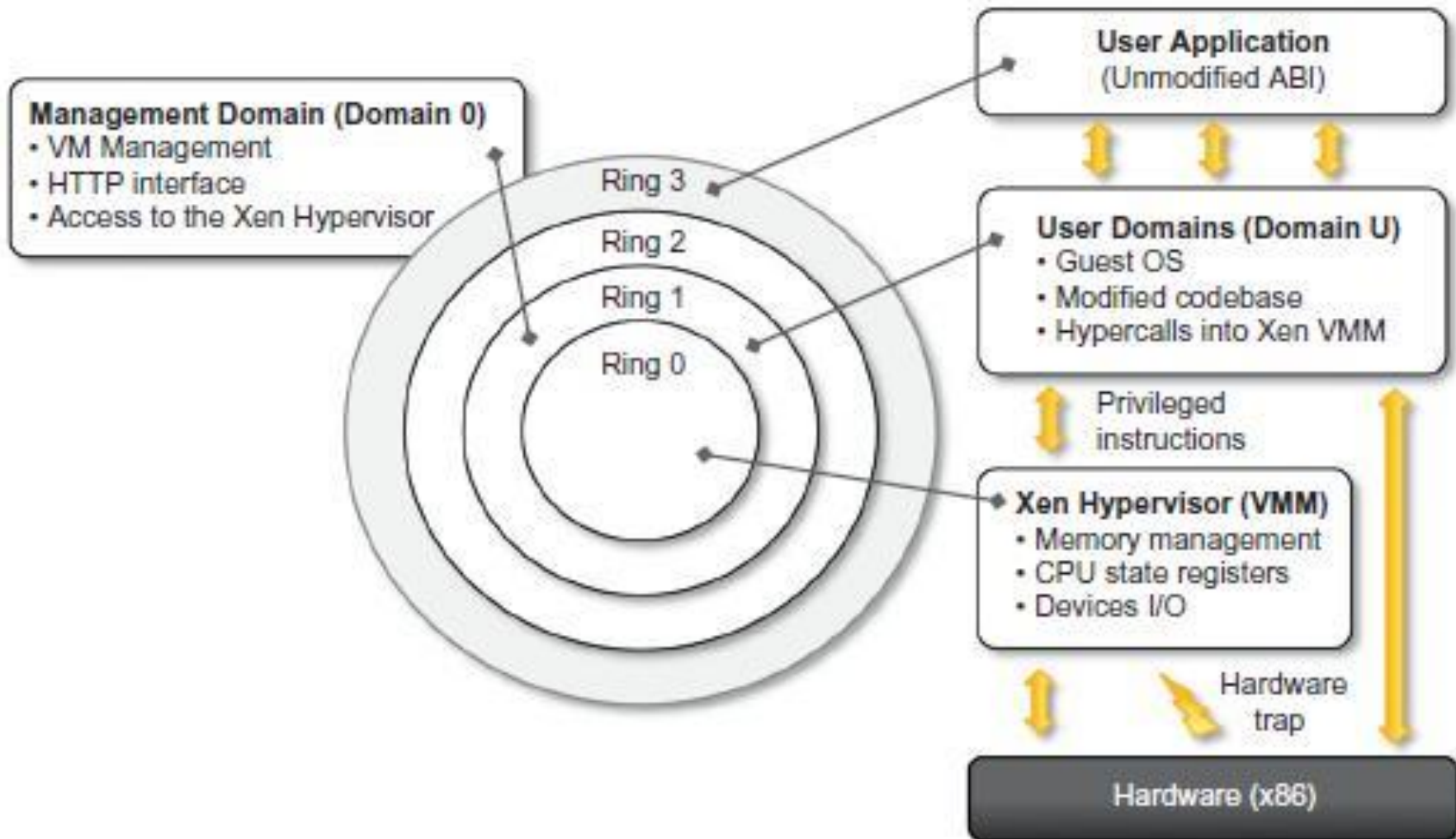
Xen Architecture

Virtual Machine Layer

Hypervisor Layer

Hardware/ Physical Layer

Xen Architecture

KVM

- Kernel-based Virtual Machine (KVM).

- An open source virtualization technology built into Linux®.

- A full virtualization solution for Linux on x86 hardware containing virtualization extensions (Intel VT or AMD-V).

How does KVM work?

KVM converts Linux into a type-1 (bare-metal) hypervisor.

Implementing KVM

- You have to run a version of Linux that was released after 2007 and it needs to be installed on X86 hardware that supports virtualization capabilities.

KVM Features

Security

Storage

Hardware Support

Memory Management

Live Migration

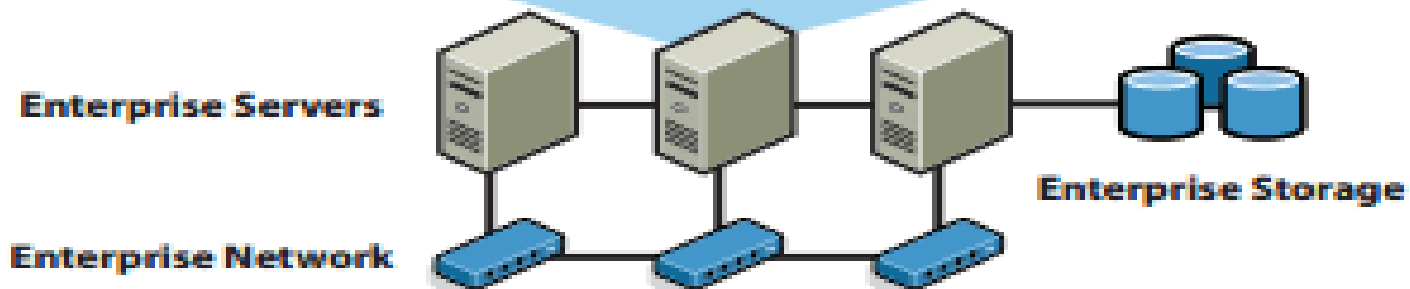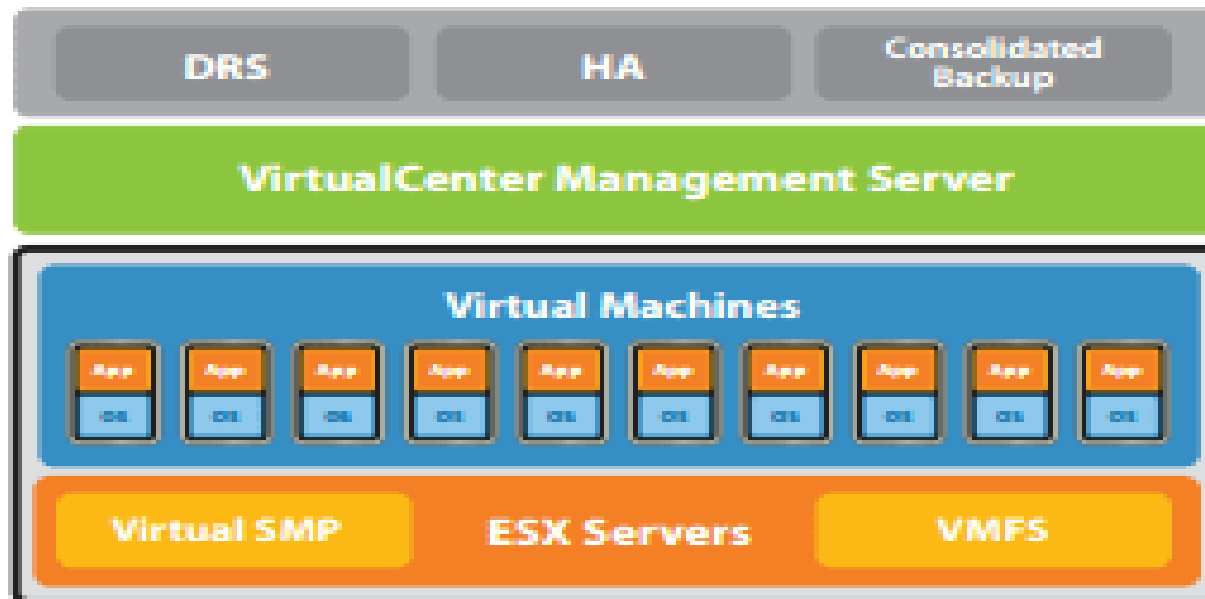Performance and Scalability

Scheduling and Resource Control

Lower Latency and Higher Prioritization

VMware Workstation

- VMware Workstation is the most dependable, high-performing, feature-rich virtualization platform for your Windows or Linux PC.

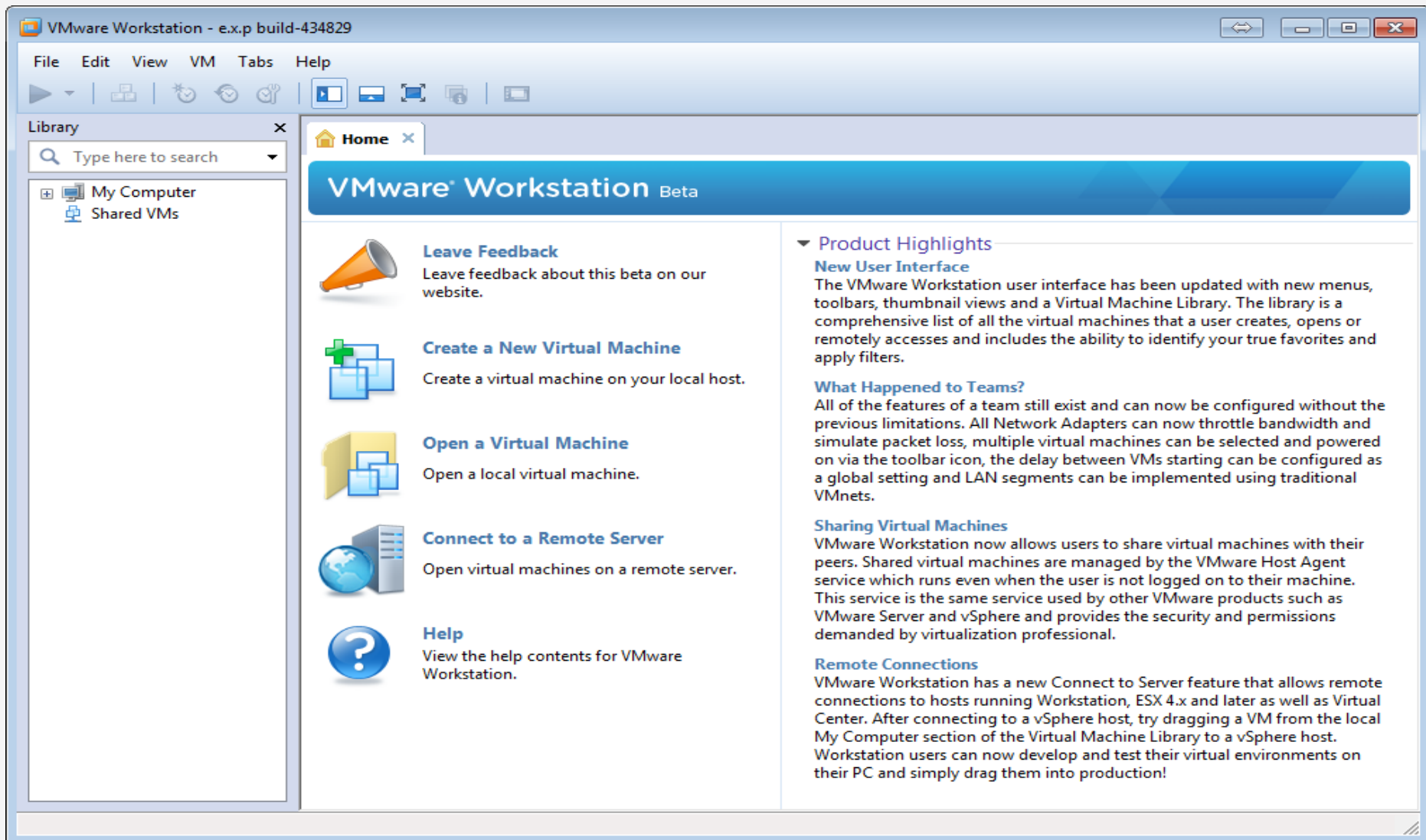- Allows one physical PC to run multiple operating systems at the same time.

VMware Workstation

- VMware's technology is based on the concept of full virtualization, where the underlying hardware is replicated and made available to the guest OS, which runs unaware of such abstraction layers and does not need to be modified.

VMware Workstation

Key Benefits of VMware

- Access anytime, anywhere.

- Run applications in Windows, Linux and other systems at the same time without restarting.

- Remotely access VMs running on VMware.

- Run as a server to host applications for your team, department or anyone in your organization.

- Create VMs that are encrypted, block USB devices and have read-only settings.

VirtualBox

- Powerful x86 and AMD64/Intel64 virtualization product for enterprise as well as home use.

- An extremely feature rich, high performance product for enterprise customers.

- Also, the only professional solution that is freely available as Open Source Software under the terms of the GNU General Public License (GPL) version 2.

VirtualBox

Oracle VM VirtualBox-

- Cross-platform virtualization application.

- Installs on your existing Intel or AMD-based computers, whether they are running Windows, Mac OS X, Linux, or Oracle Solaris operating systems (OSes).

Microsoft Hyper-V

- Primary engine that drives Windows Server 2008 "beyond virtualization" initiative.

- Hypervisor-based virtualization platform.

Microsoft Hyper-V High-level Architecture

Hyper-V High Level Architecture
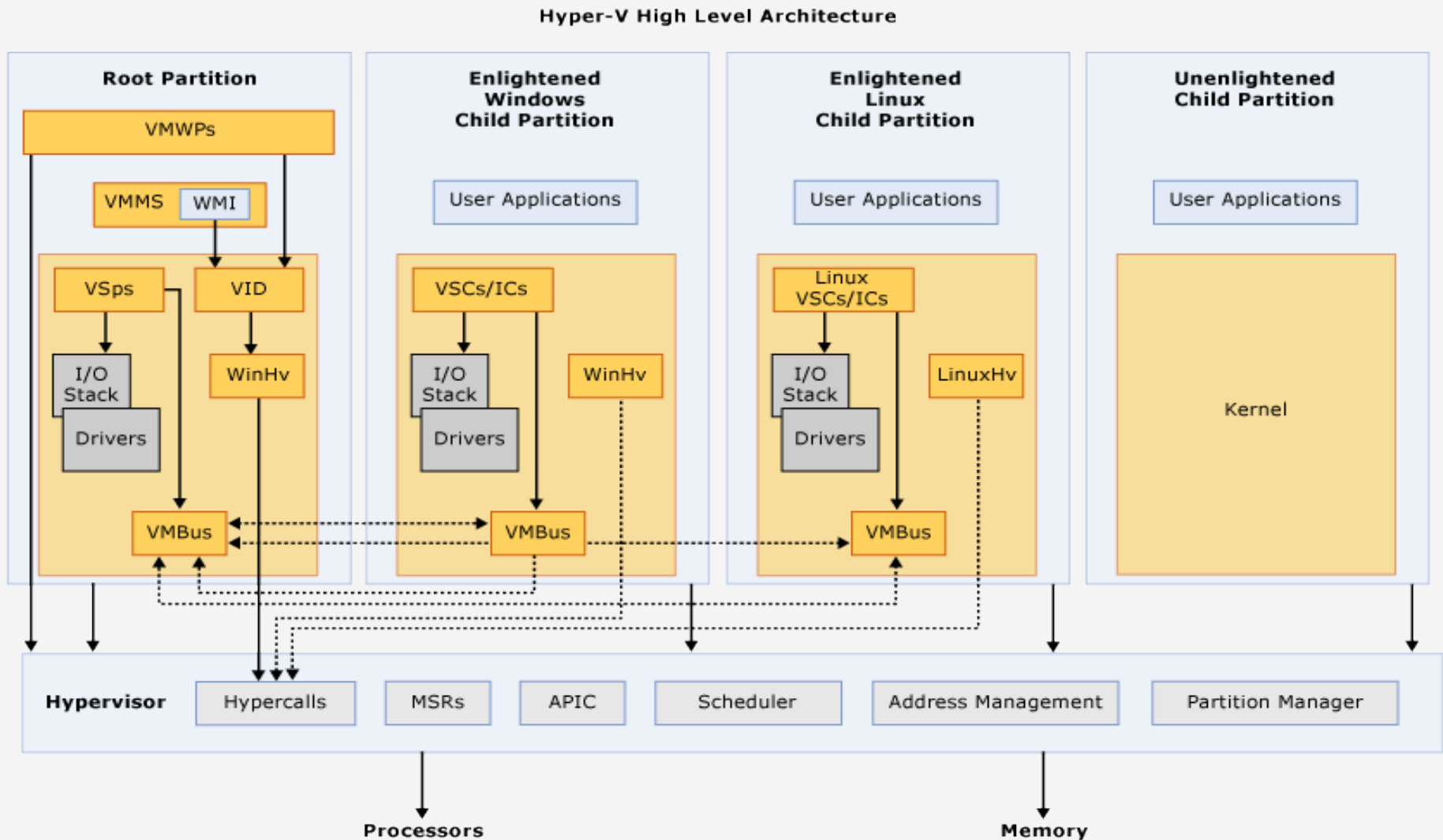
Microsoft Hyper-V High-level Architecture

- Parent partition (also called the root partition)

- Child partitions

Microsoft Hyper–V High–level Architecture

- Hypercalls Interface.

- Memory service routines (MSRs).

- Advanced Programmable Interrupt Controller (APIC).

- Scheduler.

- Partition Manager.

Microsoft Hyper-V Performance Characteristics

Hyper-V

- Improved Hardware Sharing Architecture.
- Critical Disk Performance for I/O Intensive Applications.
- Processor Hardware-assisted Virtualization Support.
- Multi-core (SMP) Guest OS Support.
- Both 32-bit and 64-bit Guest OS Support.

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Advantages of Microsoft Hyper-V Architecture

- **Consolidation of Hardware Resources.**

- Ease of Administration.

- Significant Cost Savings.

- Fault Tolerance Support through Hyper-V Clustering.

- Proven Track Record.

- Comprehensive Product Support.

- Scalability.

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Disadvantages of Using Hyper-V

- Hardware Requirements.

- Software Requirements.

That's all for now…