

Virtualization concepts-I








By

Utpal Chandra De







School of Computer Applications

KIIT [Deemed to be University]



Objectives:

-  Virtual Machines,
-  Virtualization of Clusters and Data Centers,
-  Levels of Virtualization,
-  Virtualization Structures / tools and Mechanisms,
-  Virtualization of CPU, Memory and I/O Devices,
-  Virtual Clusters and Resource Management,
-  Virtualization Data-Center Automation.




What is a virtual machine?

-  A Virtual Machine (VM) is a compute resource that uses software instead of a physical computer to run programs and deploy apps.
-  One or more virtual “guest” machines run on a physical “host” machine.
-  Each virtual machine runs its own operating system and functions separately from the other VMs, even when they are all running on the same host.
-  This means that, for example, a virtual MacOS virtual machine can run on a physical PC.
-  Virtual machine technology is used for many use cases across on-premises and cloud environments.
-  More recently, public cloud services are using virtual machines to provide virtual application resources to multiple users at once, for even more cost efficient and flexible compute.

What are virtual machines used for?

-  Virtual machines (VMs) allow a business to run an operating system that behaves like a completely separate computer in an app window on a desktop.
-  VMs may be deployed to accommodate different levels of processing power needs, to run software that requires a different operating system, or to test applications in a safe, sandboxed environment.

What are virtual machines used for? (cont.)

-  Virtual machines have historically been used for server virtualization, which enables IT teams to consolidate their computing resources and improve efficiency.
-  Additionally, virtual machines can perform specific tasks considered too risky to carry out in a host environment, such as accessing virus-infected data or testing operating systems.
-  Since the virtual machine is separated from the rest of the system, the software inside the virtual machine cannot tamper with the host computer.

How do virtual machines work?

 The virtual machine runs as a process in an application window, similar to any other application, on the operating system of the physical machine.

 Key files that make up a virtual machine include :

-  a log file,





-  NVRAM setting file,

-  virtual disk file and

-  configuration file.



Advantages of virtual machines


-  Virtual machines are easy to manage and maintain, and they offer several advantages over physical machines:
 -  VMs can run multiple operating system environments on a single physical computer, saving physical space, time and management costs.
 -  Virtual machines support legacy applications, reducing the cost of migrating to a new operating system. For example, a Linux virtual machine running a distribution of Linux as the guest operating system can exist on a host server that is running a non-Linux operating system, such as Windows.
 -  VMs can also provide integrated disaster recovery and application provisioning options.

Disadvantages of virtual machines

- ☁️ While virtual machines have several advantages over physical machines, there are also some potential disadvantages:
 - ☁️ Running multiple virtual machines on one physical machine can result in unstable performance if infrastructure requirements are not met.
 - ☁️ Virtual machines are less efficient and run slower than a full physical computer. Most enterprises use a combination of physical and virtual infrastructure to balance the corresponding advantages and disadvantages.


The two types of virtual machines

 Users can choose from two different types of virtual machines—**process VMs** and **system VMs**:

 A **process virtual machine** allows a single process to run as an application on a host machine, providing a platform-independent programming environment by masking the information of the underlying hardware or operating system.





 An example of a **process VM** is the **Java Virtual Machine**, which enables any operating system to run Java applications as if they were native to that system.

 A **system virtual machine** is fully virtualized to substitute for a physical machine.





 A system platform supports the sharing of a host computer's physical resources between multiple virtual machines, each running its own copy of the operating system.

 This virtualization process relies on a hypervisor, which can run on bare hardware, such as **VMware ESXi**, or on top of an operating system.




What are 5 types of virtualization?

-  All the components of a traditional data center or IT infrastructure can be virtualized today, with various specific types of virtualization:
-  **Hardware virtualization:** When virtualizing hardware, virtual versions of computers and operating systems (VMs) are created and consolidated into a single, primary, physical server.
 -  A hypervisor communicates directly with a physical server's disk space and CPU to manage the VMs.
 -  Hardware virtualization, which is also known as server virtualization, allows hardware resources to be utilized more efficiently and for one machine to simultaneously run different operating systems.

5 types of virtualization (cont.)

-  **Software virtualization:** Software virtualization creates a computer system complete with hardware that allows one or more guest operating systems to run on a physical host machine.
-  For example, Android OS can run on a host machine that is natively using a Microsoft Windows OS, utilizing the same hardware as the host machine does.
-  Additionally, applications can be virtualized and delivered from a server to an end user's device, such as a laptop or smartphone.
-  This allows employees to access centrally hosted applications when working remotely.

5 types of virtualization (cont.)

-  **Storage virtualization:** Storage can be virtualized by consolidating multiple physical storage devices to appear as a single storage device.
-  Benefits include increased performance and speed, load balancing and reduced costs.
-  Storage virtualization also helps with disaster recovery planning, as virtual storage data can be duplicated and quickly transferred to another location, reducing downtime.

Virtualized Storage: [the software-defined data center (SDDC)]

- ☁️ Software-defined storage (SDS) is one of the key building blocks for hyper-converged infrastructure (HCI) and the SDDC.
- ☁️ SDS abstracts physical storage constructs to enable flexible and precise consumption according to application requirements.
- ☁️ This capability is made possible by the hypervisor, which acts as a broker that balances the needs of a virtual machine and the applications it runs.






Reinventing the storage model:

- ☁️ SDS reinvents the storage model by eliminating legacy silos and enabling the true pooling of storage resources.
- ☁️ The hypervisor brings to storage the same operational efficiency that server virtualization brings to compute.
- ☁️ To enable this shift, SDS puts the application and its requirements at the top, enabling storage resources to respond to the dynamic changes in application requirements.
- ☁️ This is a change from the conventional bottom-up hardware centric approach.


How **hyper-converged infrastructure** (HCI) works?


- ☁️ HCI collapses compute, storage (including storage networking), and management onto virtualized, industry-standard hardware, enabling a building-block approach to infrastructure with scale-out capabilities.
- ☁️ In HCI, all key data center functions run as software on the hypervisor in a tightly integrated software layer.

How **hyper-converged infrastructure** (HCI) works? (cont.)

-  In an HCI environment built on SDS, where an x86 Intel-based server platform runs a hypervisor and includes virtualized storage devices, the storage software runs either in the hypervisor or in a VM.
-  The storage components are typically a mix of solid-state drives (SSDs) or hard-disk drives (HDDs).
-  Newer all-flash HCI solutions are built from SSDs (like Intel SSD Data Center Series), PCIe devices, or other flash technologies.
-  HCI implements shared storage by pooling the storage resources distributed across multiple server nodes.
-  You essentially end up with a storage-area network (SAN) inside an x86 server system.

5 types of virtualization (cont.)


 **Network virtualization:** Multiple sub-networks can be created on the same physical network by combining equipment into a single, software-based virtual network resource.


 Network virtualization also divides available bandwidth into multiple, independent channels, each of which can be assigned to servers and devices in real time.

 Advantages include increased reliability, network speed, security and better monitoring of data usage.

 Network virtualization can be a good choice for companies with a high volume of users who need access at all times.

5 types of virtualization (cont.)






 **Desktop virtualization:** This common type of virtualization separates the desktop environment from the physical device and stores a desktop on a remote server, allowing users to access their desktops from anywhere on any device.

 In addition to easy accessibility, benefits of virtual desktops include better data security, cost savings on software licenses and updates, and ease of management.

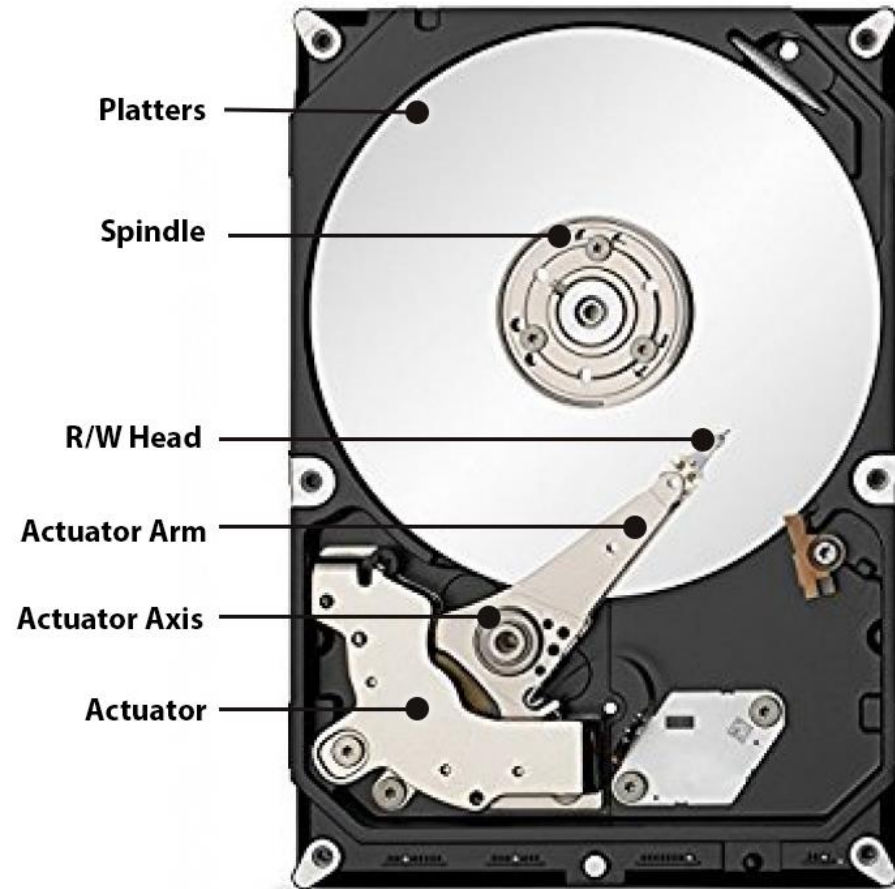
Container vs virtual machine

- ☁️ Like virtual machines, container technology such as *Kubernetes* is similar in the sense of running isolated applications on a single platform.
- ☁️ While virtual machines virtualize the hardware layer to create a “computer,” containers package up just a single app along with its dependencies.
- ☁️ Virtual machines are often managed by a hypervisor, whereas container systems provide shared operating system services from the underlying host and isolate the applications using virtual-memory hardware.

Container vs virtual machine (cont.)

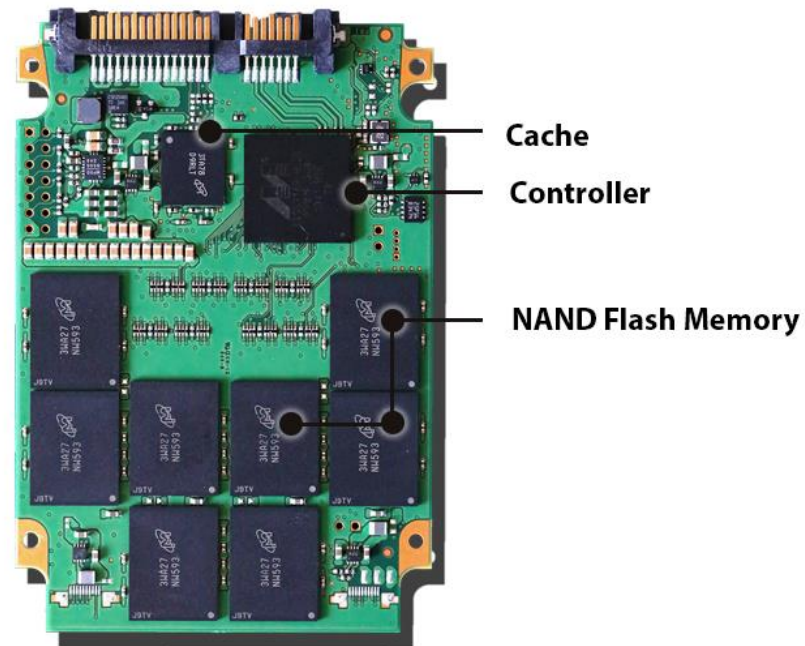
-  A key benefit of containers is that they have less overhead compared to virtual machines.
-  Containers include only the binaries, libraries and other required dependencies, and the application.
-  Containers that are on the same host share the same operating system kernel, making containers much smaller than virtual machines.
-  As a result, containers boot faster, maximize server resources, and make delivering applications easier.
-  Containers have become popular for use cases such as web applications, DevOps testing, microservices and maximizing the number of apps that can be deployed per server.

HDD 3.5"



Shock resistant up to 55g (operating)
Shock resistant up to 350g (non-operating)

SSD 2.5"



Shock resistant up to 1500g
(operating and non-operating)