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Introduction

The formation of a virtual version of something, such as a server, a desktop, a storage device, an operating system or a network resource is termed virtualization. Virtualization is a technology that allows numerous consumers and organisations to share a physical instance of a resource or application. It is done by giving a local name to a physical storage device and delivering a reference to that physical resource when needed.

Usually, business data centres include a large number of servers, the majority of which are inactive since the responsibility is fulfilled by only a few servers on the network. This wastes expensive resources like hardware, electricity, maintenance and cooling requirements. By dividing a real server into numerous virtual servers, virtualization helps to enhance the resource utilisation. These virtual servers semm and behave as if they were independent physical servers each with its operating system and applications.Virtualization is a concept that is utilised in practically every IT architecture to assist double the capacity of physical devices. It aids in making the most use of current resources, lowering total corporate costs. Hypervisors are used by businesses to construct virtual computers, networks, desktops and servers.

Background

In a typical physical computing environment, software like an Operating System or other applications has direct access to the underlying computer hardware and the components such as CPU, memory, storage, specific chipsets and OS driver versions. This caused significant problems with progress setup and made it impossible to relocate or reinstall the software on new hardware, such as when restoring backups after a breakdown or disaster. Virtualization involves the installation of a hypervisor which acts as an intermediary between the program and the underlying hardware. Once a hypervisor is installed, the software uses virtual representations of computer components such as virtual processors rather than actual processors. The hypervisor enables virtual computers to run independently of the underlying physical hardware. A virtual machine can be relocated from one physical host to another or its virtual disks can be switched from one kind of storage to another without impacting the virtual machine's operation. Because virtual machines are detached from the underlying physical hardware, virtualization enables you to pool physical computing resources like

CPUs, memory, storage and networking into pools of resources that can be made dynamically and flexibly accessible to virtual machines.

Virtualization Architecture:

The architecture in Virtualization is defined as a model that describes Virtualization conceptually. Virtualization applications in Cloud Computing is critical. In Cloud Computing, the end-users share the data on applications termed as the clouds. However, end users can share the entire IT infrastructure with Virtualization itself.
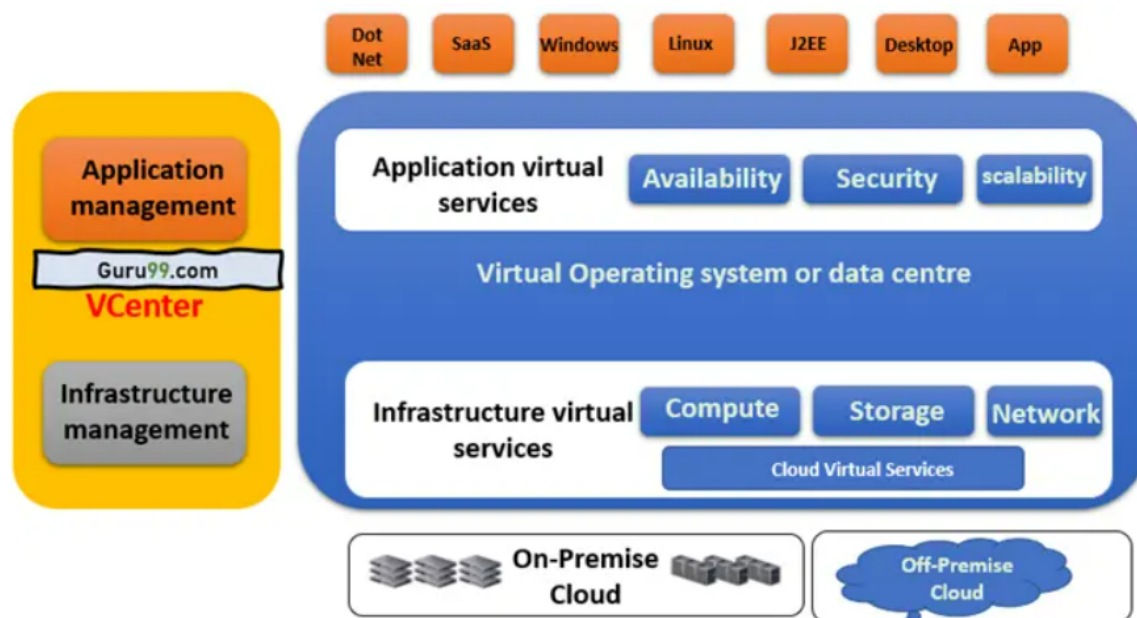

Fig: Virtualization Architecture

In the above image, Virtualization comprises virtual application and infrastructure virtual services. The virtual application services help in application management, and the virtualinfrastructure services can help in infrastructure management.

Both services are embedded into a virtual data centre or an operating system. The virtual services can be used in any platform and programming environment. The services can be accessed through an on-premise cloud or an off-premise cloud.

Virtualization services are delivered to cloud users by third-party individuals. The cloud users, in return, have to pay third-party individuals with an applicable monthly or annual fee.

This fee is paid to compensate the third parties to provide cloud services to end-users, and they also provide different versions of applications as requested by the end cloud users.

Virtualization is generally achieved through the hypervisor. A hypervisor enables the separation of operating systems with the underlying hardware. It enables the host machine to run many virtual machines simultaneously and share the same physical computer resources.

Types of Virtualization:

Virtualization can be categorised into different types based on the components where virtualization occurs. The variants available under virtualization technology are listed below:
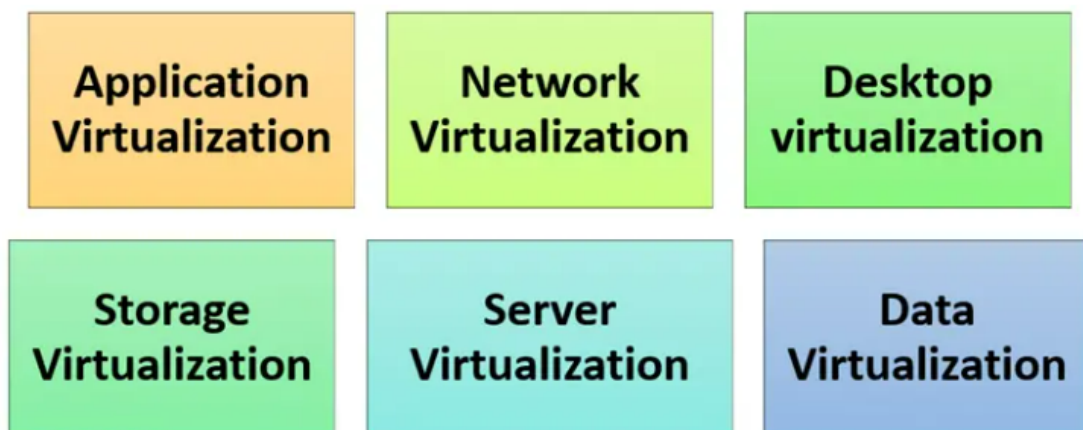

Fig:Types of Virtualization

Application Virtualization

This can be defined as the type of Virtualization that enables the end-user of an application to have remote access.This is achieved through a server. This server has all personal information and other applicable characteristics required to use the application.The server is accessible through the internet, and it runs on a local workstation. With Application virtualization, an end-user can run two different versions of the same software or the same application.Application virtualization is offered through packaged software or a hosted application.

Network Virtualization

This kind of virtualization can execute many virtual networks, and each has a separate control and data plan. It co-occurs on the top of a physical network, and it can be run by parties who are not aware of one another. Network virtualization creates virtual networks, and it also maintains a provision of virtual networks. Through network virtualization, logical switches, firewalls, routers, load balancers, and workload security management systems can be created.

Desktop Virtualization

This can be defined as the type of Virtualization that enables the operating system of end-users to be remotely stored on a server or data centre. It enables the users to access their desktops remotely and do so by sitting in any geographical location. They can also use different machines to virtually access their desktops.

With desktop virtualization, an end-user can work on more than one operating systems basis the business need of that individual. If the individual wants to work on an operating system other than the Window Operating System, he can use desktop virtualization. This provides the individual an opportunity to work on two different operating systems.

Therefore, desktop virtualization delivers a host of benefits. It delivers portability, user mobility, easy software management with patches and updates.

Storage Virtualization

This type of Virtualization provides virtual storage systems that facilitate storage management. It facilitates the management of storage effectively and through multiple sources accessed from a single repository. Storage virtualizations ensure consistent performance and smooth performance. It also offers continuous updates and patches on advanced functions. It also helps cope with the changes that come up in the underlying storage equipment.

Server Virtualization

This kind of Virtualization ensures masking of servers. The main or the intended server is divided into many virtual servers. Such servers keep changing their identity numbers and processors to facilitate the masking process. This ensures that each server can run its own operating systems in complete isolation.

Data Virtualization

This can be defined as the type of Virtualization wherein data are sourced and collected from several sources and managed from a single location. There is no technical knowledge from where such data is sourced and collected, stored, or formatted for such data.

The data is arranged logically, and the interested parties and stakeholders then access the virtual view of such data. These reports are also accessed by end-users on a remote basis.

The application of data virtualization ranges from data integration to business integration. They are also used for service-oriented architecture data services, and they help find organisational data.

Characteristics of Virtualization:

Virtualization offers several features or characteristics as listed below:

- Distribution of resources:

  Virtualization and Cloud Computing technology ensure end-users develop a unique computing environment. It is achieved through the creation of one host machine. Through this host machine, the end-user can restrict the number of active users. By doing so, it facilitates easy control. They can also be used to bring down power consumption.

- Accessibility of server resources:

  Virtualization delivers several unique features that ensure no need for physical servers. Such features ensure a boost to uptime, and there is less fault tolerance and availability of resources.

- Resource Isolation:

  Virtualization provides isolated virtual machines. Each virtual machine can have many guest users, and guest users could be either operating systems, devices, or applications. The virtual machine provides such guest users with an isolated virtual environment. This ensures that the sensitive information remains protected, and, at the same time, guest users remain inter-connected with one another.

- Security and authenticity:

  The virtualization systems ensure continuous uptime of systems, and it does automatic load balancing and ensures there is less disruption of services.

- Aggregation:

  Aggregation in Virtualization is achieved through cluster management software. This software ensures that the homogenous sets of computers or networks are connected and act as one unified resource.

Advantages of Virtualization

- Virtualization offers several benefits, such as it helps in cost reduction and boosting productivity towards the development process.
- It does away with the need to have a highly complex IT infrastructure.
- It facilitates remote access to resources and ensures that it promotes faster scalability.
- It is highly flexible, and it allows the users to execute multiple desktops operating systems on one standard machine.
- It removes the risks involved in terms of system failures, and it also boosts flexible data transfer between different virtual servers.
- The working process in Virtualization is highly streamlined and agile, which ensures that the users work and operate most economically.

Disadvantages of Virtualization

The disadvantages of Virtualization are very much limited in nature. Here are the cons/disadvantages of Virtualization:

- The transition of the existing hardware setup to a virtualized setup requires an extensive time investment, and hence this can be regarded as a time-intensive process.
- There is a lack of availability of skilled resources that helps in terms of transition of existing or actual setup to virtual setup.
- Since there is a limitation in terms of having less skilled resources, the implementation of Virtualization calls for high-cost implementations.
- If the transition process is not handled meticulously, it also poses a security risk to sensitive data.

Hypervisor

A hypervisor is a form of virtualization software used in Cloud hosting to divide and allocate the resources on various pieces of hardware. The program which provides partitioning, isolation, or abstraction is called a virtualization hypervisor. The hypervisor is a hardware virtualization technique that allows multiple guest operating systems (OS) to run on a single host system at the same time. A hypervisor is sometimes also called a virtual machine manager(VMM).

Types of Hypervisor :

TYPE-1 Hypervisor:

The hypervisor runs directly on the underlying host system. It is also known as a "Native Hypervisor" or "Bare metal hypervisor". It does not require any base server operating system. It has direct access to hardware resources. Examples of Type 1 hypervisors include VMware ESXi, Citrix XenServer, and Microsoft Hyper-V hypervisor.

Pros & Cons of Type-1 Hypervisor:

Pros: Such kinds of hypervisors are very efficient because they have direct access to the physical hardware resources(like Cpu, Memory, Network, and Physical storage). This causes the empowerment of the security because there is nothing of any kind of the third party resource so that the attacker couldn't compromise with anything.

Cons: One problem with Type-1 hypervisors is that they usually need a dedicated separate machine to perform their operation and to instruct different VMs and control the host hardware resources.

TYPE-2 Hypervisor:

A Host operating system runs on the underlying host system. It is also known as 'Hosted Hypervisor". Such hypervisors don't run directly over the underlying hardware, rather they run as an application in a Host system(physical machine). Basically, the software is installed on an operating system. Hypervisor asks the operating system to make hardware calls. An example of a Type 2 hypervisor includes VMware Player or Parallels Desktop. Hosted hypervisors are often found on endpoints like PCs. The type-2 hypervisor is very useful for engineers, and security analysts (for checking malware, or malicious source code and newly developed applications).

Pros & Cons of Type-2 Hypervisor:

Pros: Such kind of hypervisors allow quick and easy access to a guest Operating System alongside the host machine running. These hypervisors usually come with additional useful features for guest machines. Such tools enhance the coordination between the host machine and the guest machine.

Cons: Here there is no direct access to the physical hardware resources so the efficiency of these hypervisors lags in performance as compared to the type-1 hypervisors, and potential security risks are also there an attacker can compromise the security weakness if there is access to the host operating system so he can also access the guest operating system.

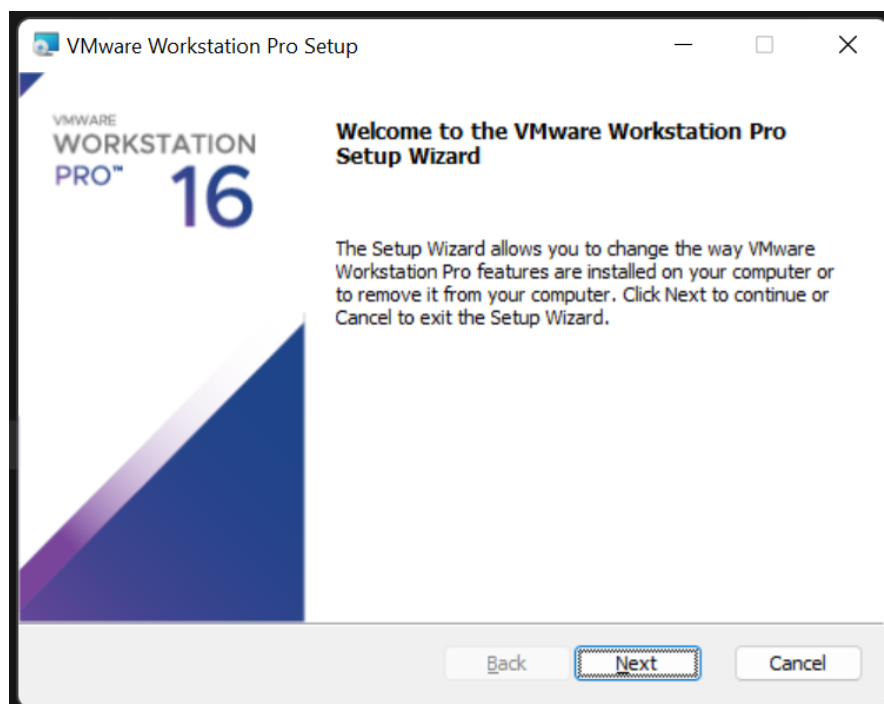# Practical Implementation of Operating System Virtualization

CentOs installation with VMware in Windows:

a. VMware Installation

Step1:Navigate to the following website and download the installer
https://www.vmware.com/latam/products/workstation-pro/workstation-pro-evaluation.html
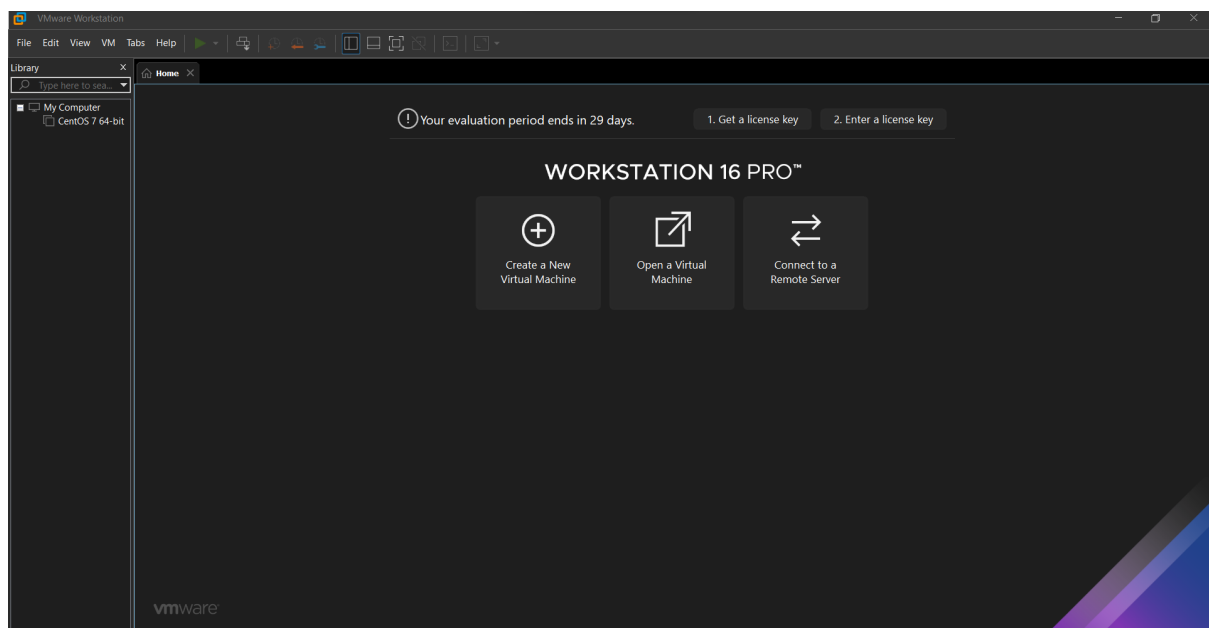

Step 2: After downloading, open the installer and you see the window

Step 3: Follow the steps until the installation is done that later displays the window as below. As the setup is a trial version you select the second option and click continue.
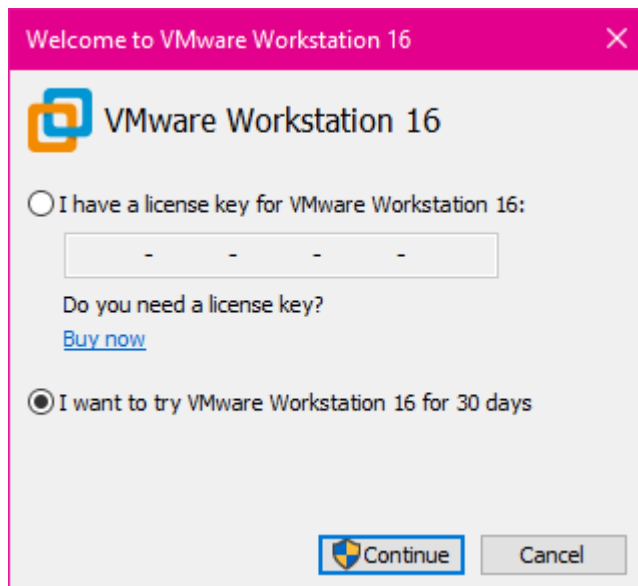
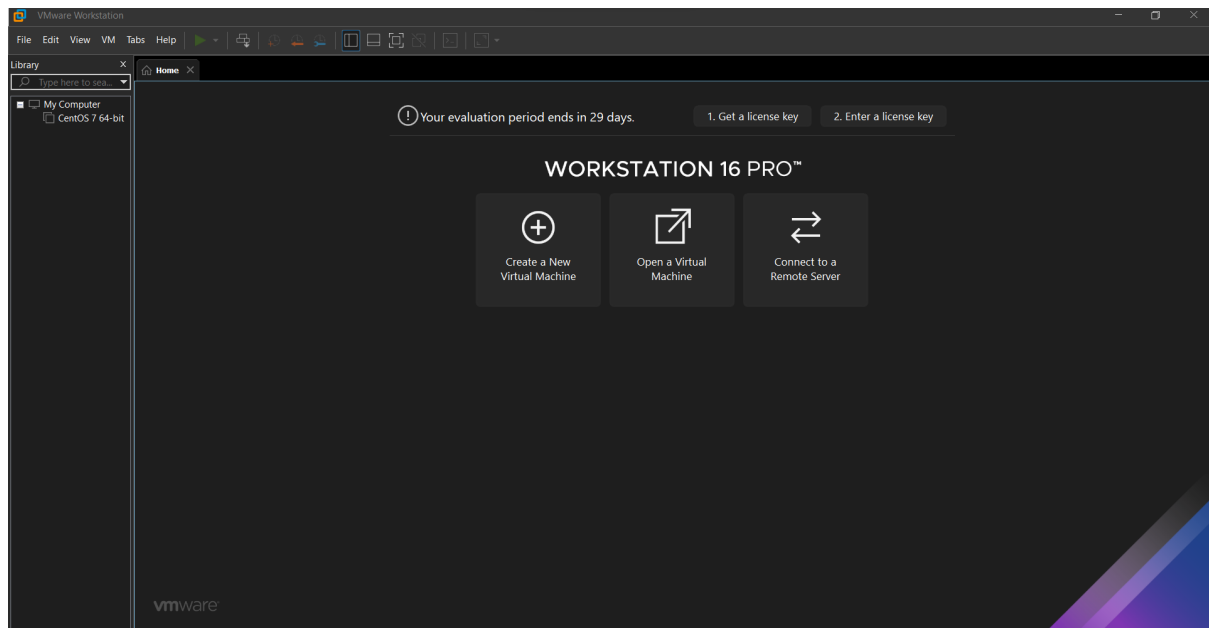The VMware workstation Pro 16 now opens as follows.

b.CentOS Installation:

Step 1: Download CentOS ISO

Download the CentOS 7.9 ISO file from the official site.

Step 2: Click on Create a New Virtual Machine in VMware Workstation Pro

Step 3: Select recommended settings and select the ISO file in the next page.

New Virtual Machine Wizard   ✕

Guest Operating System Installation

A virtual machine is like a physical computer; it needs an operating system. How will you install the guest operating system?

Install from:

◯ Installer disc:

No drives available   ⌄

🔘 Installer disc image file (iso):

C:\Users\mjebi\Desktop\CentOS-7-x86_64-Minimal-2 ⌄   [Browse...]

ℹ️ CentOS 7 64-bit detected.

◯ I will install the operating system later.

The virtual machine will be created with a blank hard disk.

[Help]   [< Back]   [Next >]   [Cancel]

New Virtual Machine Wizard   ✕

Name the Virtual Machine
What name would you like to use for this virtual machine?

Virtual machine name:

CentOS 7 64-bit (2)

Location:

C:\Users\mjebi\Documents\Virtual Machines\CentOS 7 64-bit (Browse...

The default location can be changed at Edit > Preferences.

< Back   Next >   Cancel

New Virtual Machine Wizard   ✕

Specify Disk Capacity
    How large do you want this disk to be?

The virtual machine's hard disk is stored as one or more files on the host
computer's physical disk. These file(s) start small and become larger as you add
applications, files, and data to your virtual machine.

Maximum disk size (GB):   20.0 ⬍

Recommended size for CentOS 7 64-bit: 20 GB

⦿ Store virtual disk as a single file
⦿ Split virtual disk into multiple files
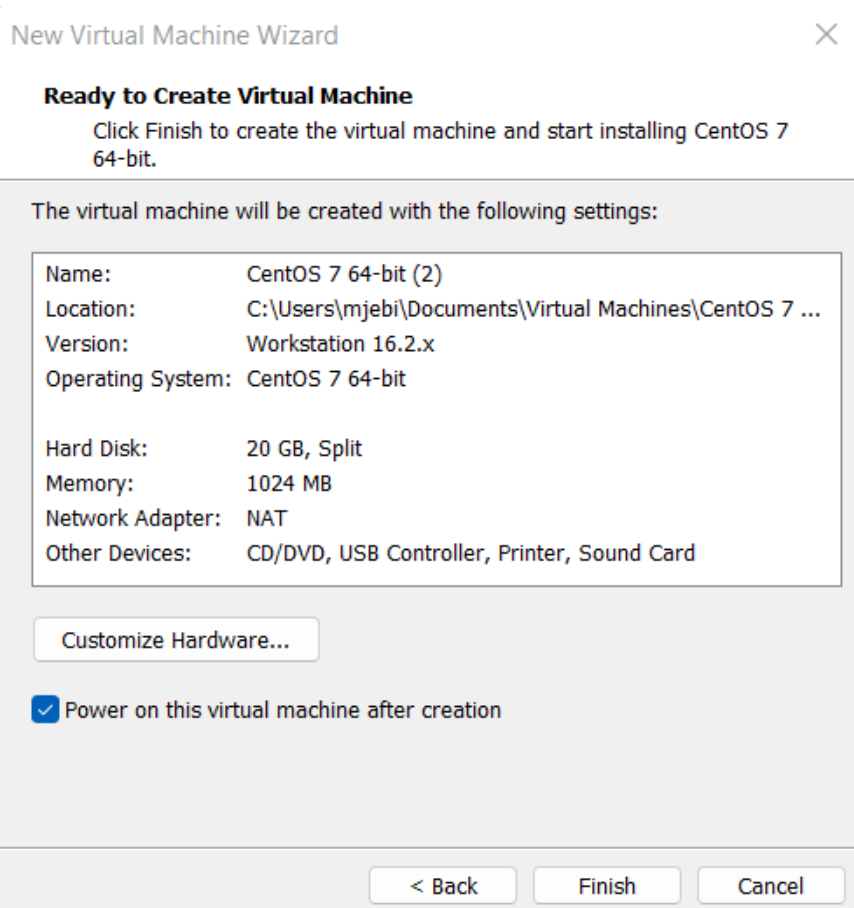
    Splitting the disk makes it easier to move the virtual machine to another
    computer but may reduce performance with very large disks.
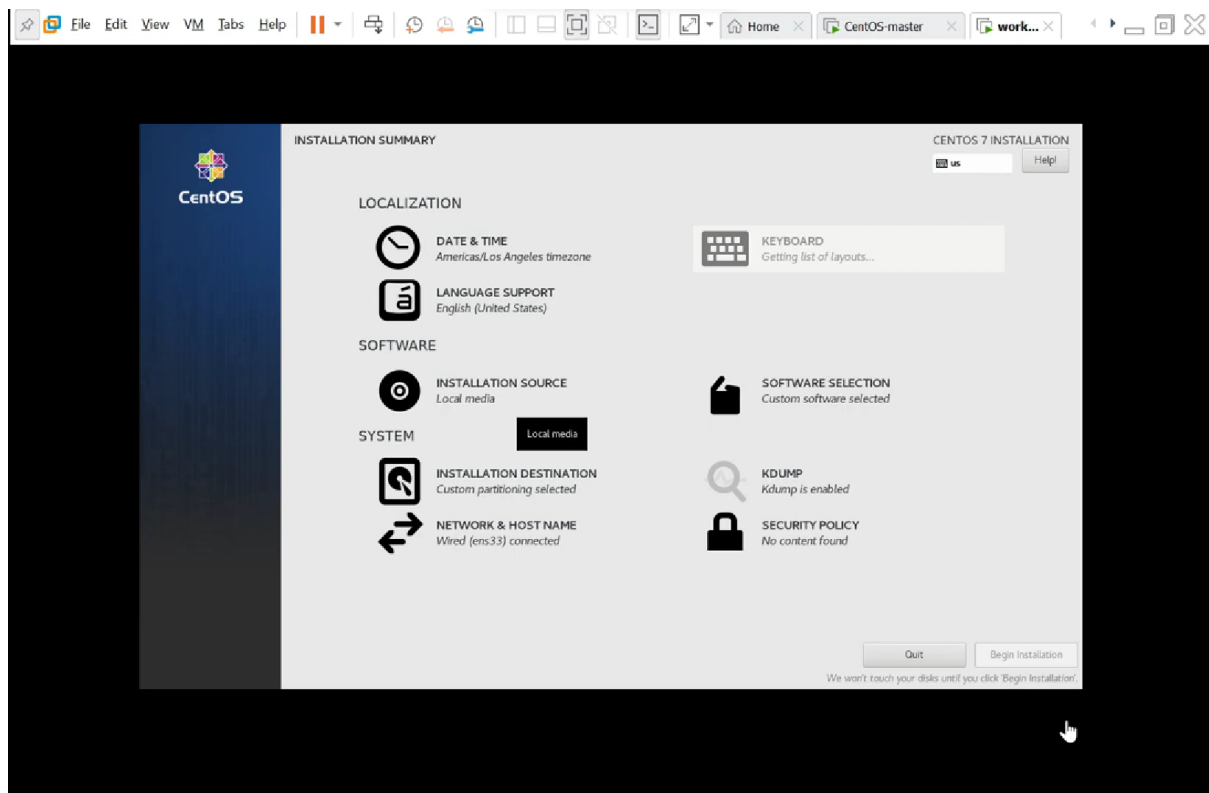
| Help | | < Back | Next > | Cancel |

Step 4: Follow along the steps till the OS boots up

Step5: Set a password for the root user.

Step 6: Reboot the machine once the installation is completed.