Introduction

Background

Operating systems are the programs that make a computer run and let other apps work Understanding how operating systems are installed. configured, and managed is essential for students studying information systems and computer science. Traditionally, installing an operating system required a separate physical computer, which could be costly and time-consuming.

With the advancement of virtualization technology, it is now possible to run multiple operating systems on a single computer safely and efficiently. Virtual machines allow users to test, experiment, and practice system administration without affecting the host computer.

Motivation

The main motivation for this project is to provide hands-on experience with operating system installation using a virtual environment. By working with virtualization tools such as Oracle VirtualBox, students can:

- Learn the step-by-step process of installing a Linux-based operating system (CentOS Stream).
- Explore system configuration, resource allocation, and filesystem management in a safe environment.
- Develop practical skills in troubleshooting and managing virtual systems.
- Prepare for real-world system administration tasks and gain confidence in using modern computing tools.

This project lets students try OS installation in a virtual setup, so they can learn by doing, not just reading.

Objectives

The objectives of this project are to provide practical experience with operating systems, hardware, and virtualization technology. The main goals are:

1. Virtual Installation of Operating Systems
    - Understand and perform OS installation in a virtual environment.
    - Apply concepts such as boot process, partitioning, and file systems.
    - Gain hands-on experience without affecting the host system.
    - Develop troubleshooting and system configuration skills.
    - Explore OS features like memory management, CPU scheduling, and device drivers.
    - Learn about virtualization and its role in modern computing.
    - Get comfortable managing a real system
2. Worldwide PC Brands
    - Identify major PC manufacturers and their system architectures.
    - Understand hardware diversity and OS compatibility.
    - Link OS performance to hardware specifications.
    - Make informed decisions when selecting hardware.
    - Learn how different PCs and phones affect what OS works best
3. Worldwide Mobile Phone Brands
    - Recognize major mobile brands and their operating systems.
    - Understand how hardware differences affect mobile OS performance.
    - Study OS ecosystems and brand influence on development.
    - Compare processors, memory, and storage across devices.
    - Analyze OS portability, fragmentation, and trends in mobile technology.

Reference to Evaluation Tasks (Excel Sheets)

In addition to the operating system installation task, this project includes an evaluation of worldwide PC brands and mobile phone brands based on the given criteria. These evaluations were performed using Microsoft Excel to ensure accurate comparison and analysis.

The Excel sheets for PC brand evaluation and mobile phone brand evaluation are submitted as separate files and uploaded in their respective GitHub repositories. These Excel files are referenced as supporting materials for this documentation.

Requirements

i. Hardware

- Processor: Intel Core i7-4600U CPU (64-bit)
- RAM: 8 GB
- Storage: 119 GB SSD
- Graphics: Intel HD Graphics
- System Type**:** 64-bit, x64-based processor

Note: The system is sufficient to run a virtual machine with CentOS Stream 10 (recommended: 2 GB RAM, 1 CPU core, 20 GB disk).

ii. Software

- Host OS**:** Windows 10 (64-bit)
- Virtualization Software: Oracle VirtualBox
- Operating System ISO**:** CentOS Stream 10 x86_64

Download CentOS Stream ISO

The first step in preparing the installation environment is to download the CentOS Stream ISO file from the official CentOS Stream website. The ISO file contains all necessary files to install the operating system.

The CentOS Stream download page provides ISO images for various system architectures, including:

- 64-bit x86 (x86_64)
- ARM64 (AArch64)
- IBM Power (ppc64le)
- IBM Z (s390x)

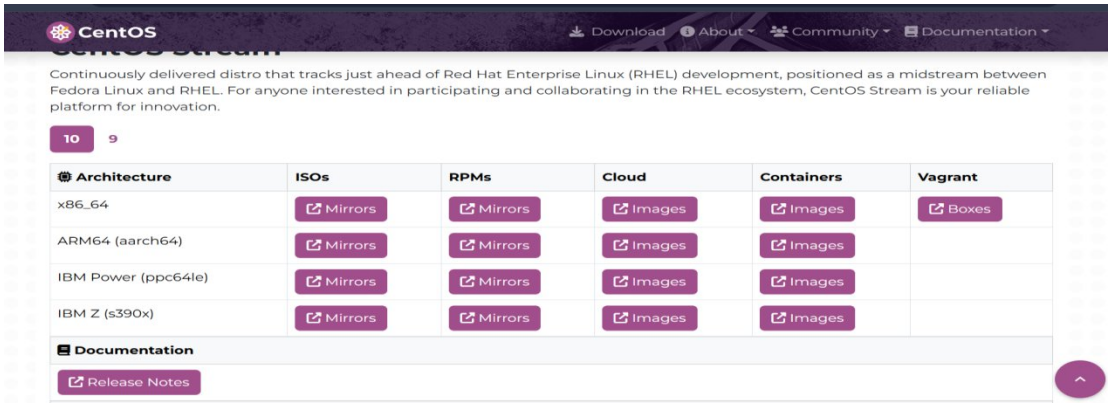

Figure 1: CentOS Stream download page showing available ISO images for different system architectures (x86_64, ARM64, IBM Power, IBM Z).

For this project, the x86_64 architecture is selected because the host computer uses an Intel Core i7 64-bit processor, which is fully compatible with this architecture and supported by virtualization software such as VMware Workstation and Oracle VirtualBox.After selecting the CentOS Stream 10 x86_64 ISO, the file is downloaded and saved to the local computer. This ISO file will later be used to create a virtual machine and start the installation process.

Set Up the Virtual Machine (Oracle VirtualBox)

After downloading the CentOS Stream ISO file, a virtual environment must be prepared to install the operating system.
Virtualization allows an operating system to run inside another operating system without affecting the host machine.

For this project, Oracle VirtualBox is used as the virtualization tool because it is free, stable, widely used in academic environments, and fully supports Linux-based operating systems such as CentOS Stream.

Software Preparation

Downloaded Oracle VirtualBox from the official site to install on the computer

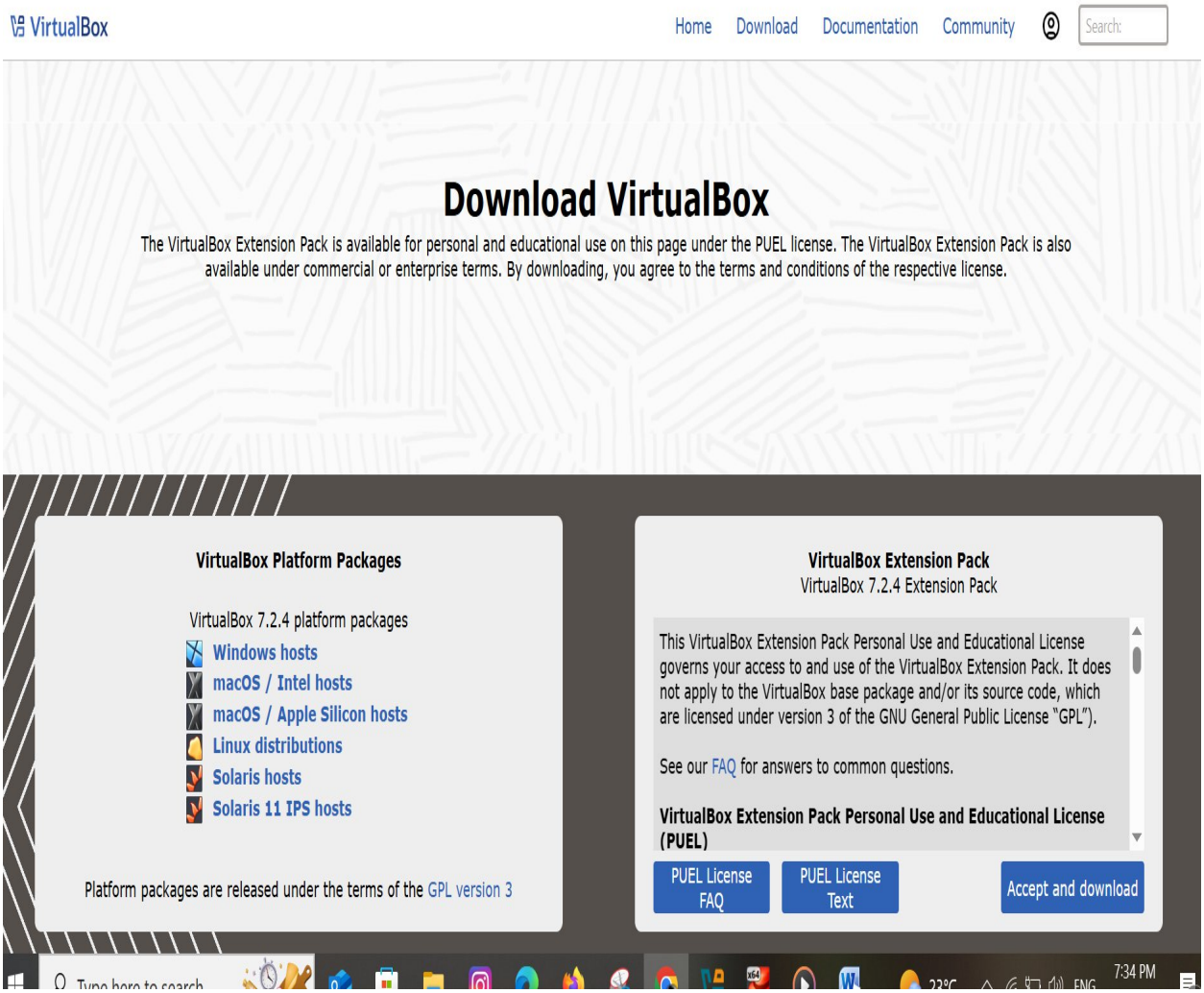

Figure 2: Oracle VirtualBox download page showing the available platform packages for installation

Installation of Oracle VirtualBox

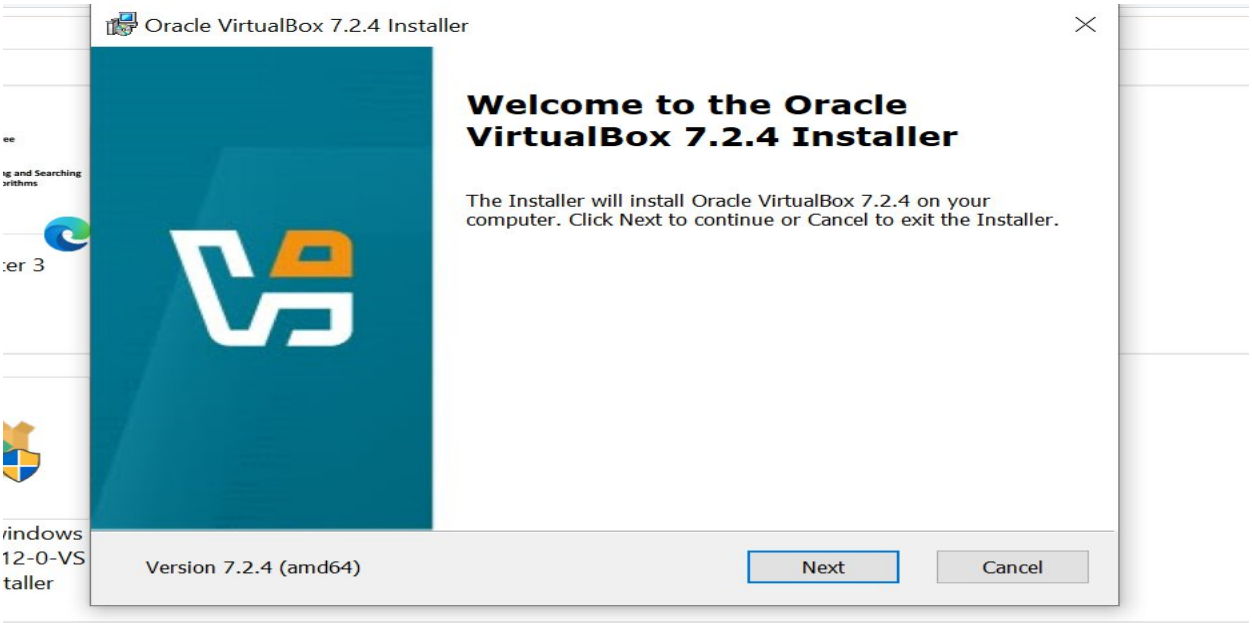

Figure 3: Oracle VirtualBox installation welcome screen, displayed at the start of the setup process

After launching the Oracle VirtualBox installer, the setup wizard opens with a welcome screen. This screen confirms that the installation process has started and guides the user through the installation steps.

End User License Agreement

After the welcome screen, the End User License Agreement (EULA) is displayed. This screen presents the legal terms and conditions for using Oracle VirtualBox. The installation process can continue only after accepting the license agreement

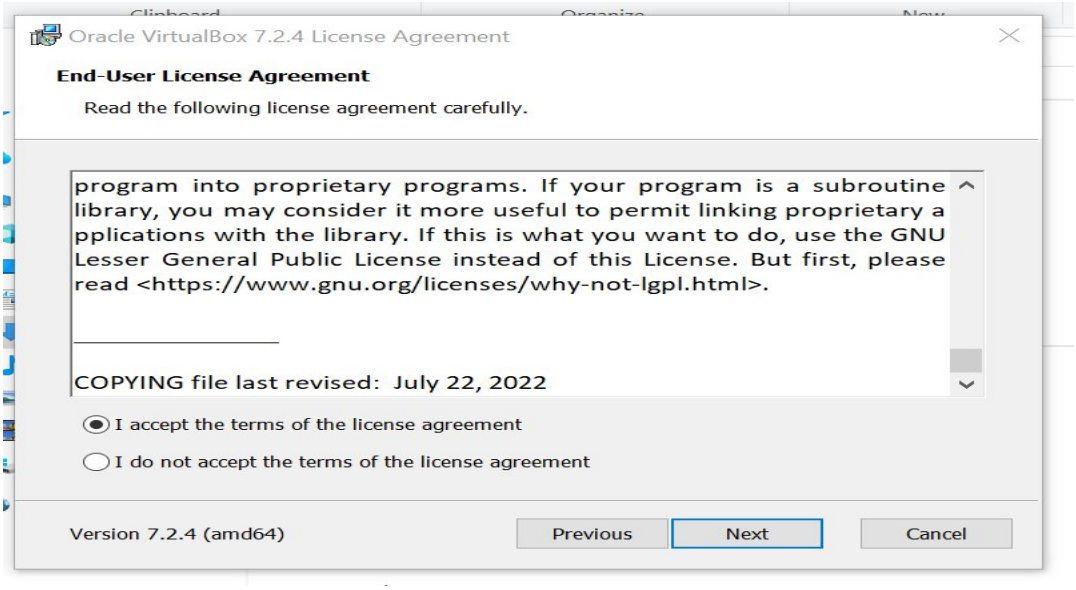

Figure 4: Oracle VirtualBox End User License Agreement (EULA) screen, requiring acceptance to continue the installation

Custom Setup

It allows the user to choose where VirtualBox will be installed and which components will be installed.

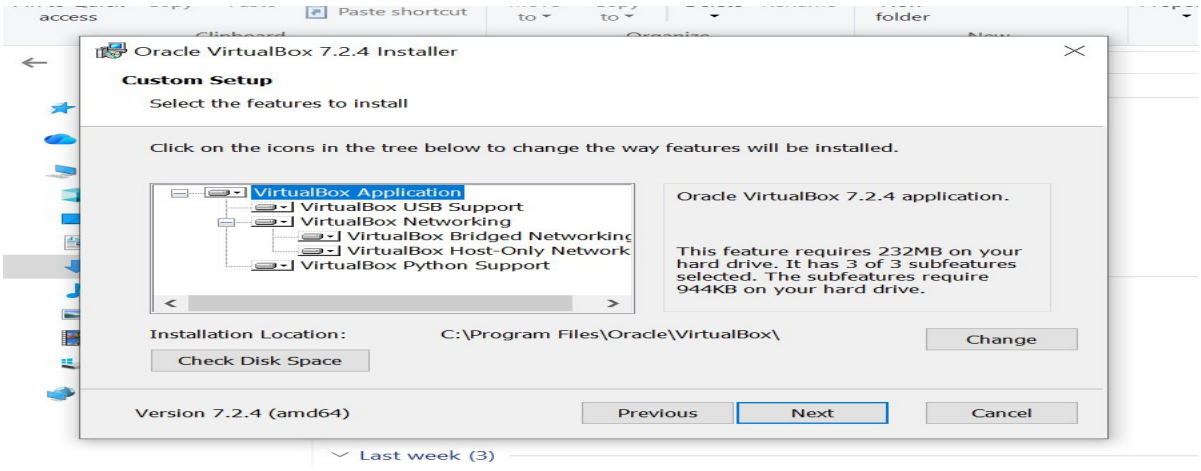

Figure 5: Oracle VirtualBox Custom Setup screen

The Custom Setup screen allows the user to review and confirm the installation location and components of Oracle VirtualBox. In this project, the default installation settings were selected to ensure full functionality and compatibility with the host system. No changes were made to the default configuration.

Network interface warning

During installation, a warning message may appear indicating temporary network disconnection. This occurs because VirtualBox installs virtual network drivers. The interruption is temporary and normal.

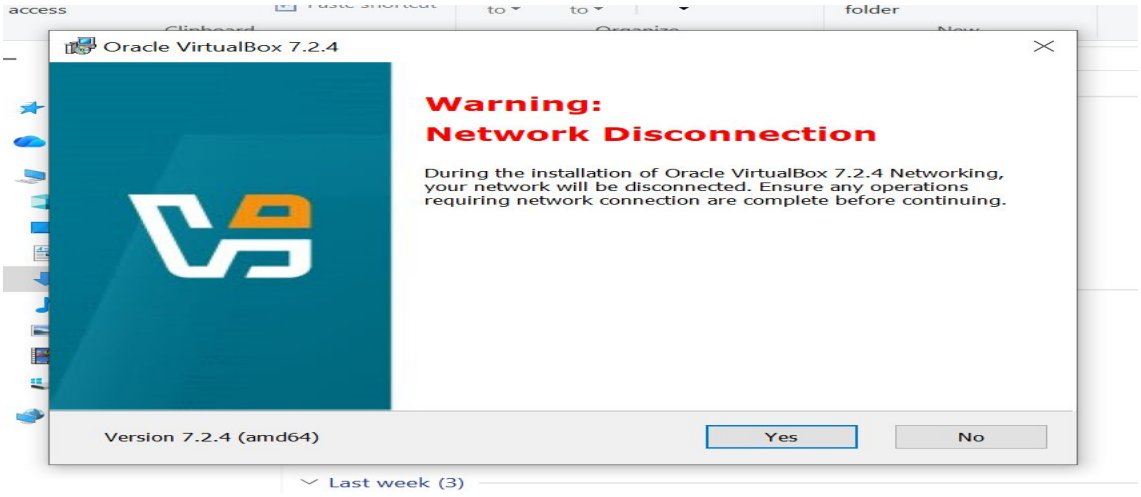

Figure 6: Network interface warning during Oracle VirtualBox installation

After confirming the installation settings, the setup wizard begins installing Oracle VirtualBox. During this stage, required files are copied and system components are configured. The installation process required a few minutes while VirtualBox installed the necessary components.

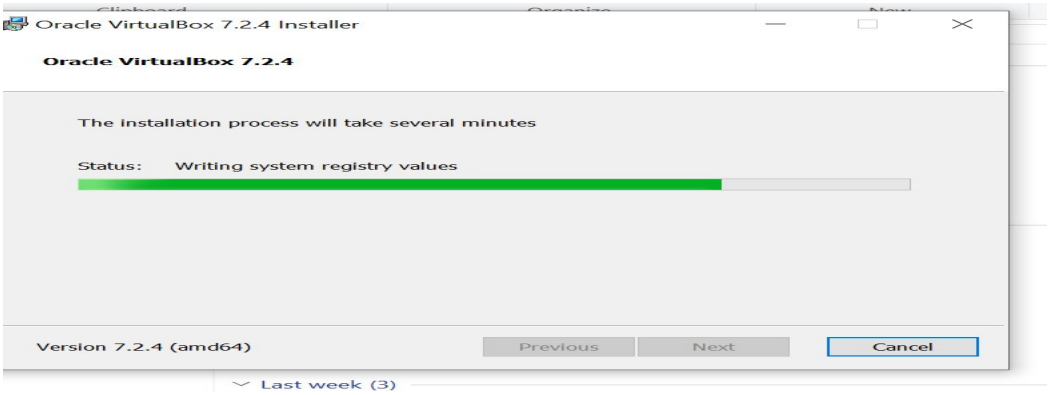

Figure 7: Oracle VirtualBox installation progress screen, showing files being copied and system components configured

Creating the CentOS Stream Virtual Machine

After successfully installing Oracle VirtualBox, the next step is to create a virtual machine (VM) that will host the CentOS Stream operating system. A virtual machine acts like a real computer, allowing CentOS Stream to run inside the host system without affecting the existing operating system.

In this project, CentOS Stream 10 (x86_64) is installed using Oracle VirtualBox.

Steps followed:

1. Oracle VirtualBox is launched from the desktop or Start menu
2. Click Create New Virtual Machine.

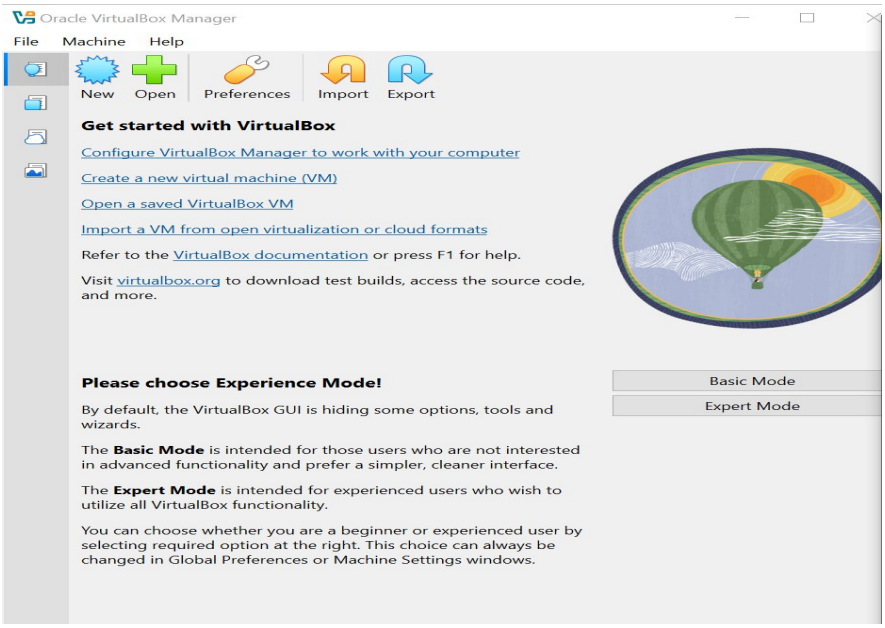

Figure 8: Oracle VirtualBox main interface showing the option to create a new virtual machine

3. Choose the option to install the operating system from an ISO file.
4. Browse and select the previously downloaded CentOS Stream 10 x86_64 ISO.

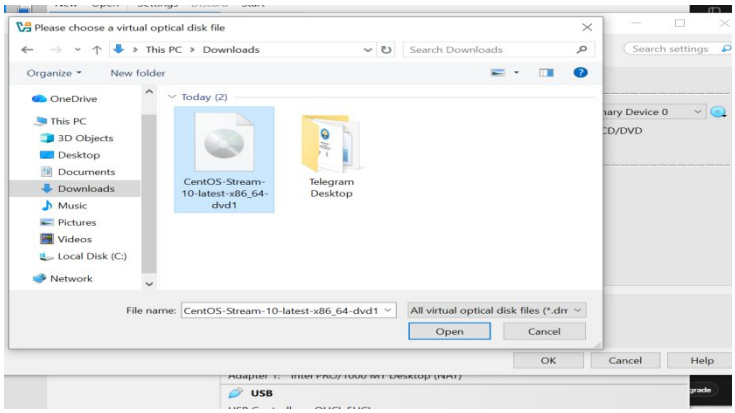

Figure 9: Selecting the CentOS Stream 10 x86_64 ISO file

5. Set the operating system type as Linux and version as CentOS / Red Hat (64-bit).

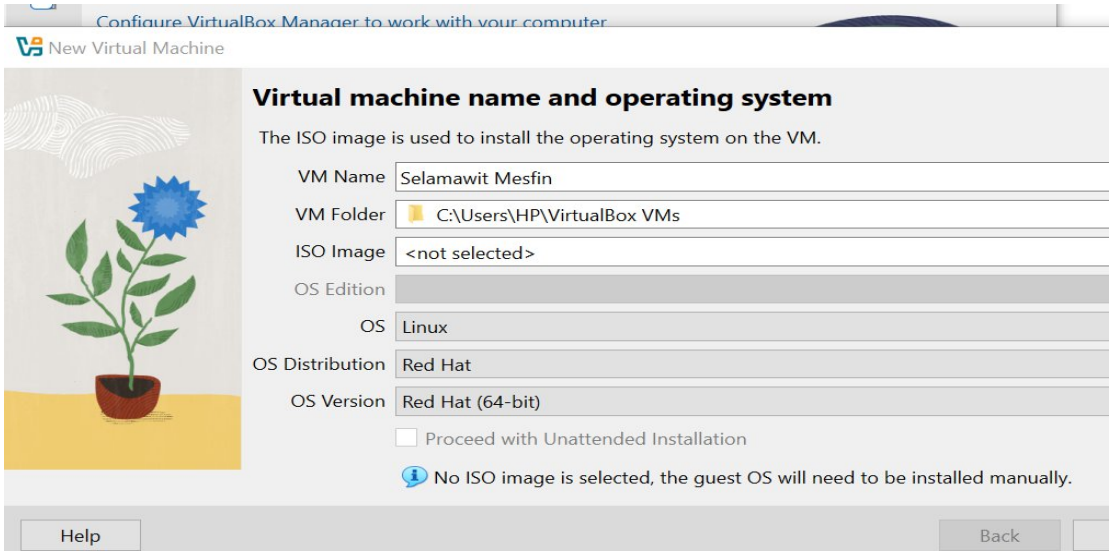

Figure 10: Setting the operating system

Assign system resources to the virtual machine:

- Memory (RAM): At least 2 GB
- Processor 1 CPU core
- Storage: At least 20 GB virtual disk space

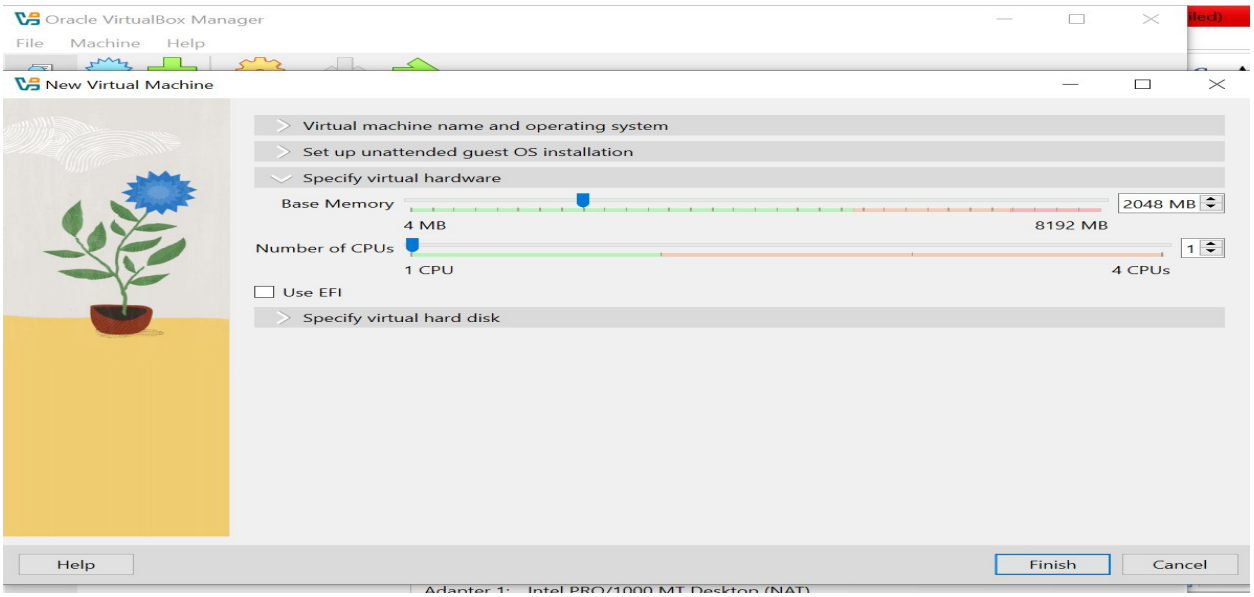

Figure 11: Allocating system resources for the virtual machine

Create and configure the virtual hard disk

- Disk type: VDI (VirtualBox Disk Image)
- Storage: Dynamically allocated
- Disk size: At least 20 GB

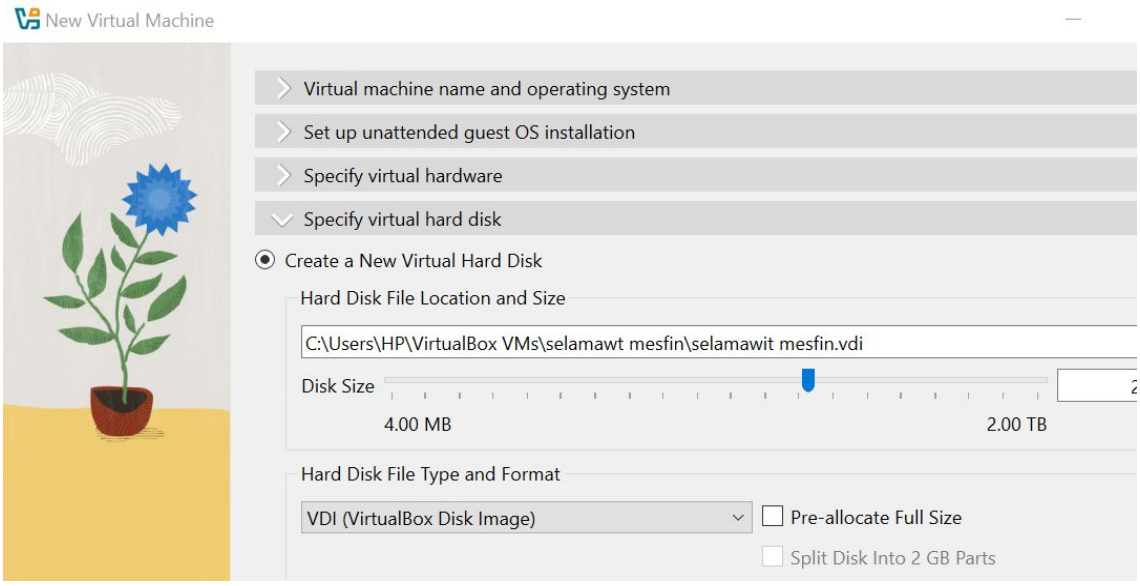

Figure 12: Creating and configuring the virtual hard disk

Finish the setup and save the virtual machine configuration.

Once these steps are completed, the virtual machine is ready to start the CentOS Stream 10 installation.

Start the CentOS Stream Installation

After setting up the virtual machine, the next step is to boot from the ISO file and initiate the CentOS Stream 10 installation.

Procedure:

1. Open Oracle VirtualBox and select the newly created virtual machine.
2. Click Start to power on the VM.

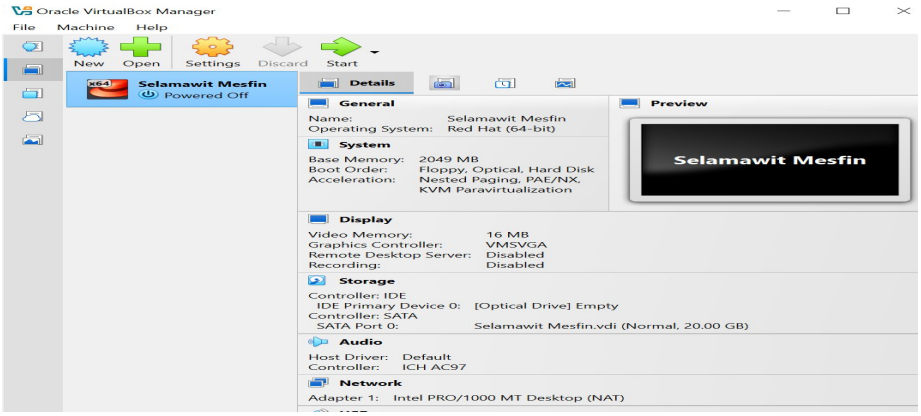

Figure 13: Starting the newly created CentOS Stream virtual machine in Oracle VirtualBox

3. Ensure that the CentOS Stream ISO is mounted as the primary boot device.
    - Go to Settings → Storage, and confirm the ISO is attached under the Optical Drive.
    - Make sure the Optical Drive is listed above the Hard Disk so the VM boots from the ISO first.

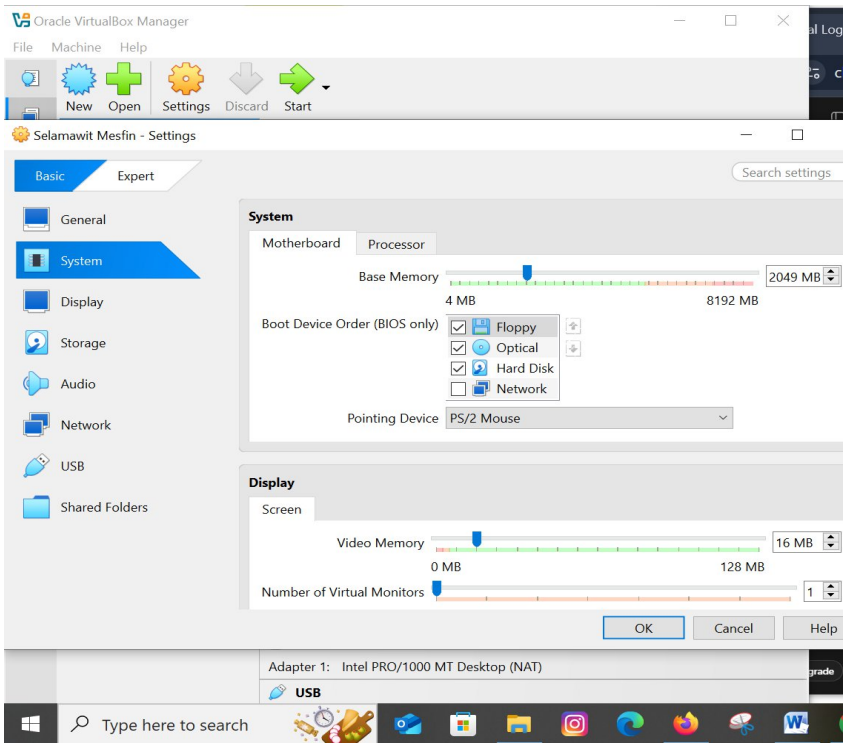

Figure 14: Confirming that the CentOS Stream ISO is mounted as the primary boot device in Oracle VirtualBox setting

4. The VM will display the GRUB boot menu. Press Enter to start the installer.

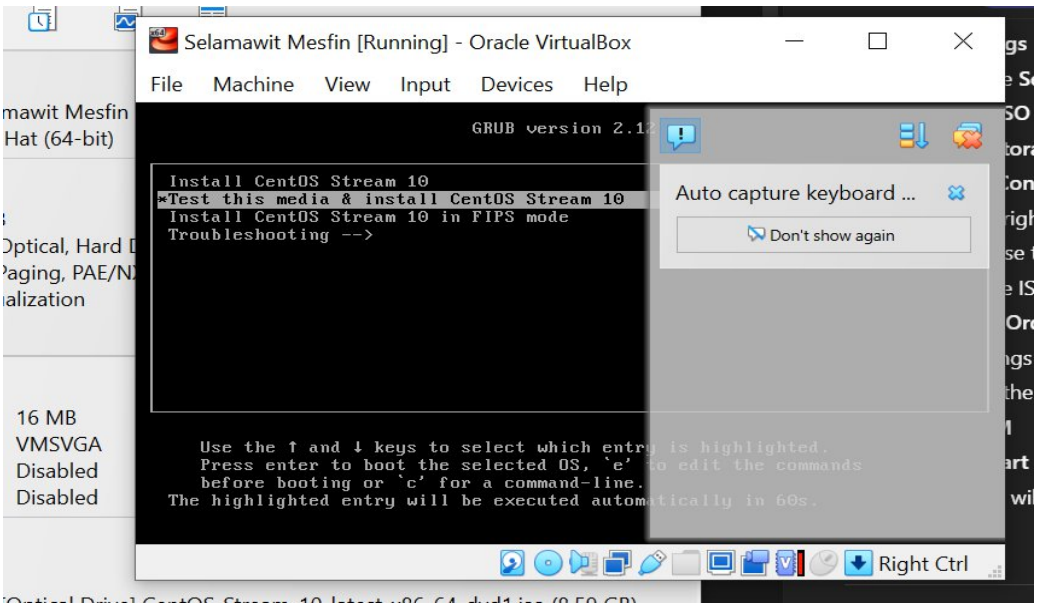

Figure 15: GRUB boot menu displayed on the CentOS Stream virtual machine

- After selecting the installer in the GRUB menu, CentOS Stream begins booting.
- The screen will turn black with scrolling white text. This is CentOS starts loading the system files.
- Wait until it finishes loading. This usually ends when the Welcome to CentOS Stream screen appears

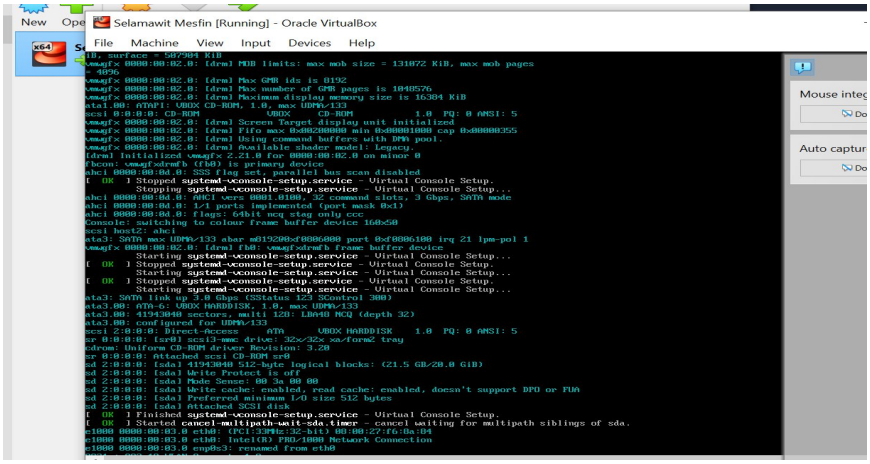

Figure 16: CentOS Stream booting process in the virtual machine, showing the kernel loading and system initialization

5. The CentOS Stream Welcome screen appears. Use the keyboard to navigate and press Enter to continue.

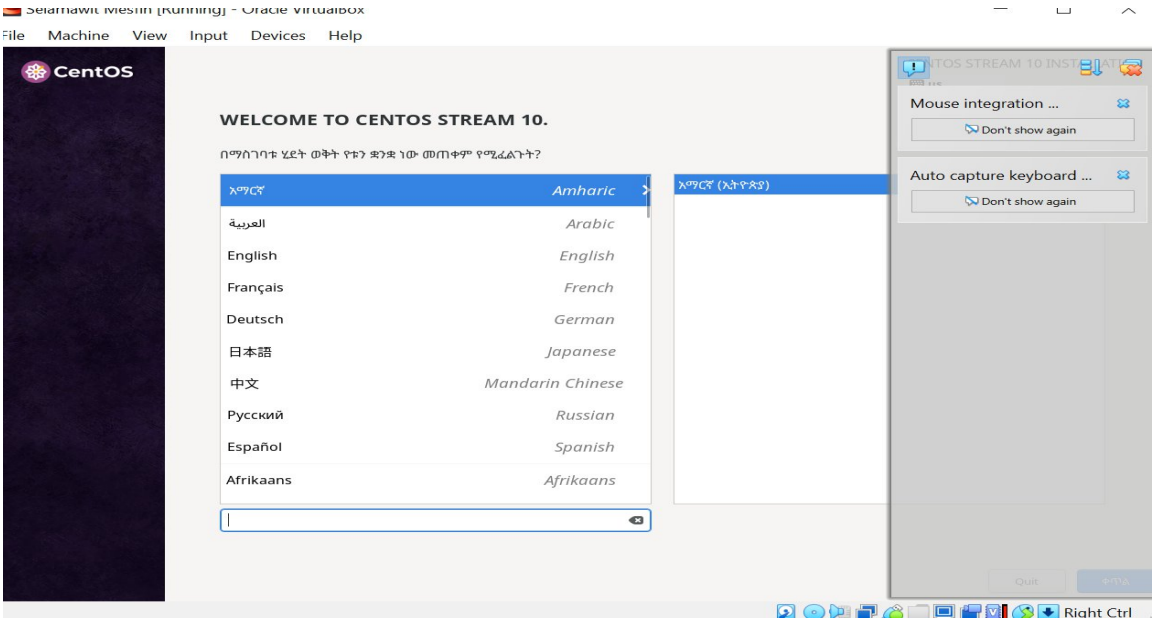

Figure 17: CentOS Stream Welcome screen in the virtual machine, prompting the user to continue the installation

6. Select Installation Destination

The installer will prompt for the installation destination, which is the virtual hard disk where CentOS will be installed.

Procedure:

1. Click Installation Destination.

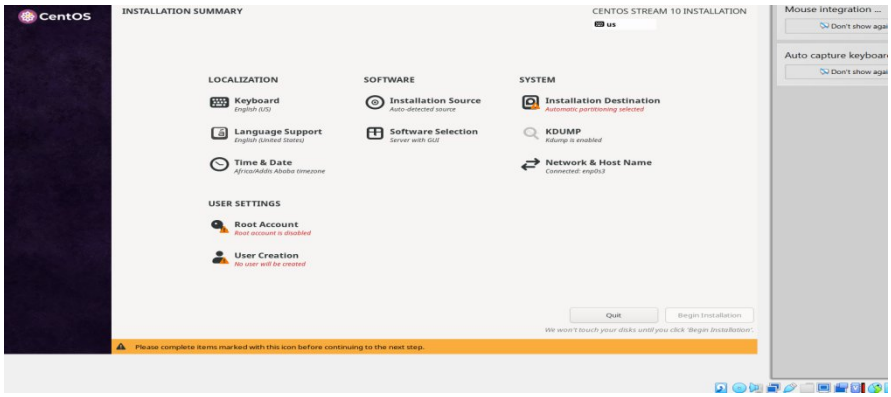

Figure 18: Installation Summery screen

2. Ensure the virtual hard disk ATA VBOX HARDDISK is selected.
3. Choose Automatic storage configuration (default).
4. Click Done to confirm the selection.

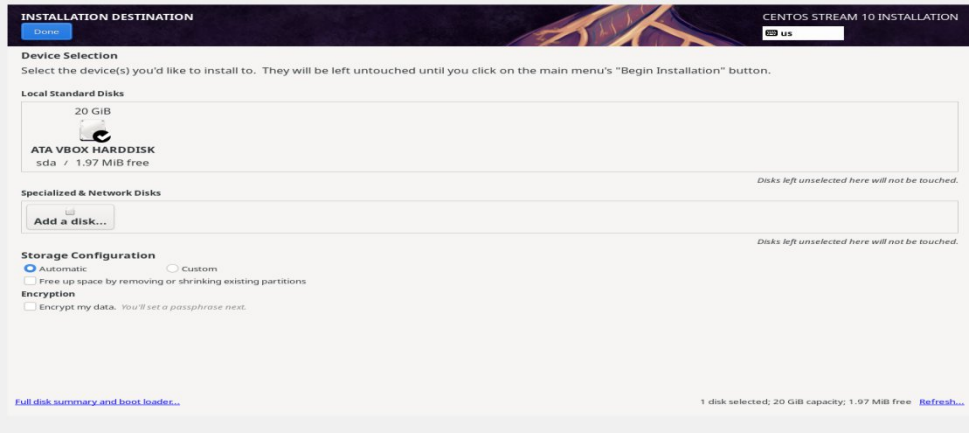

Figure 19: Installation Destination screen

Note: If no disk appears, ensure that the virtual hard disk was correctly created in VirtualBox during the VM setup.

Configure User and Root Accounts

CentOS require at least one administrative user and optionally the root account.

Procedure:

1. Click User Settings.
2. Create an administrative user:
    - Full Name: Selamawit Mesfin
    - Username: selisha
    - Password: A secure password was set following system requirements.
    - Enable Administrator privileges.

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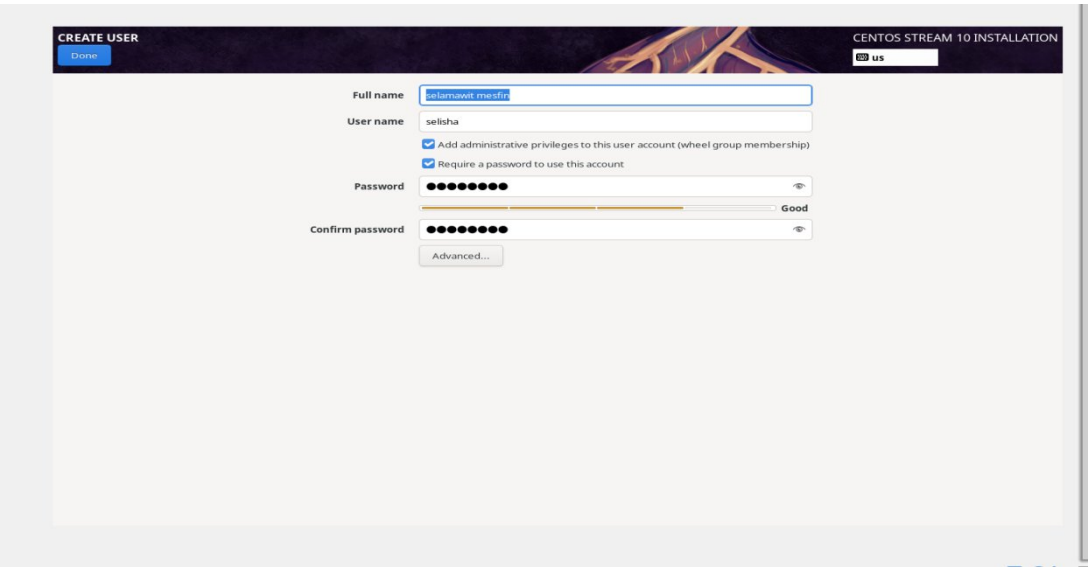

Figure 20: Create user screen

Click Done to save user settings.

- On the Installation Summary screen, click Network & Hostname.
- Enable the network interface by toggling it ON.
- set the hostname for your virtual machine (e.g., centos-stream-10)
- Click Apply and then Done to return to the Installation Summary.

This ensures the VM can communicate over networks and is properly identified on the system.

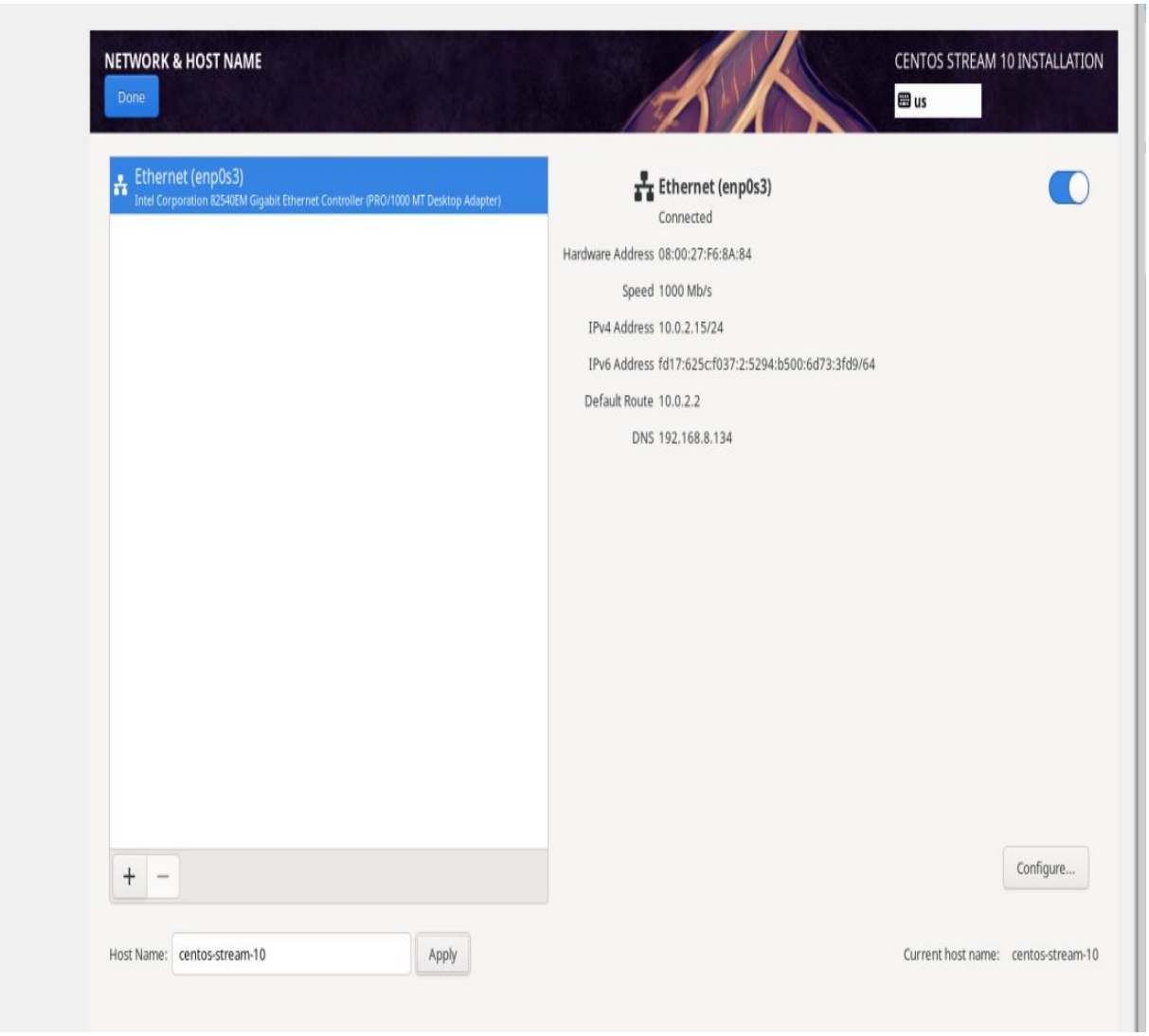

Figure 21: Network and Host name screen

Root Password Setup

1. Click Root Password.
2. Enter a strong password for the root account.
3. Click Done to return to the installation progress.

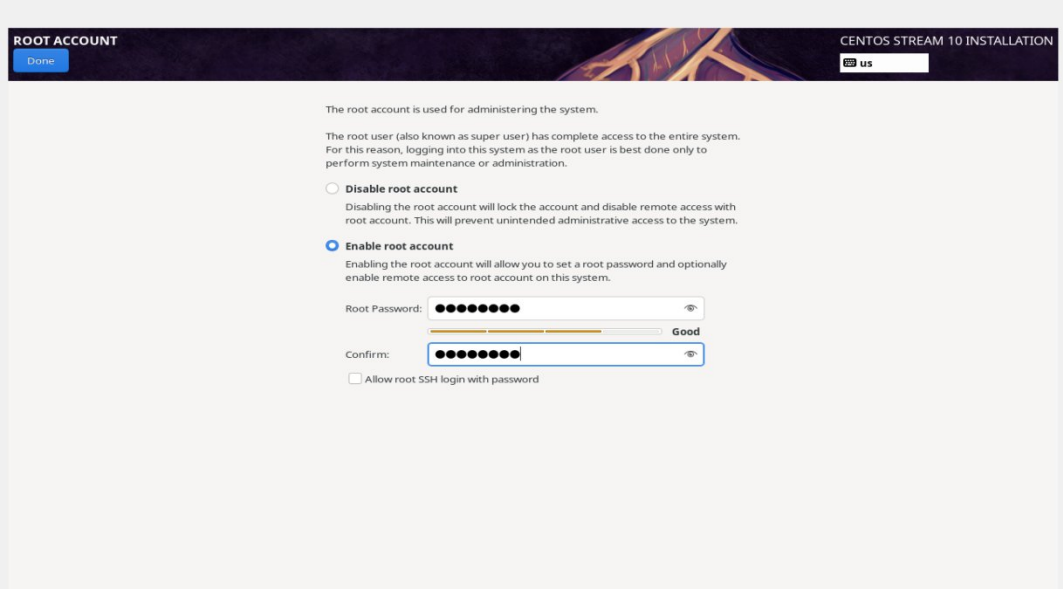

Figure 22: Root account screen

Begin Installation

1. After completing all required configurations, the installation process was started.

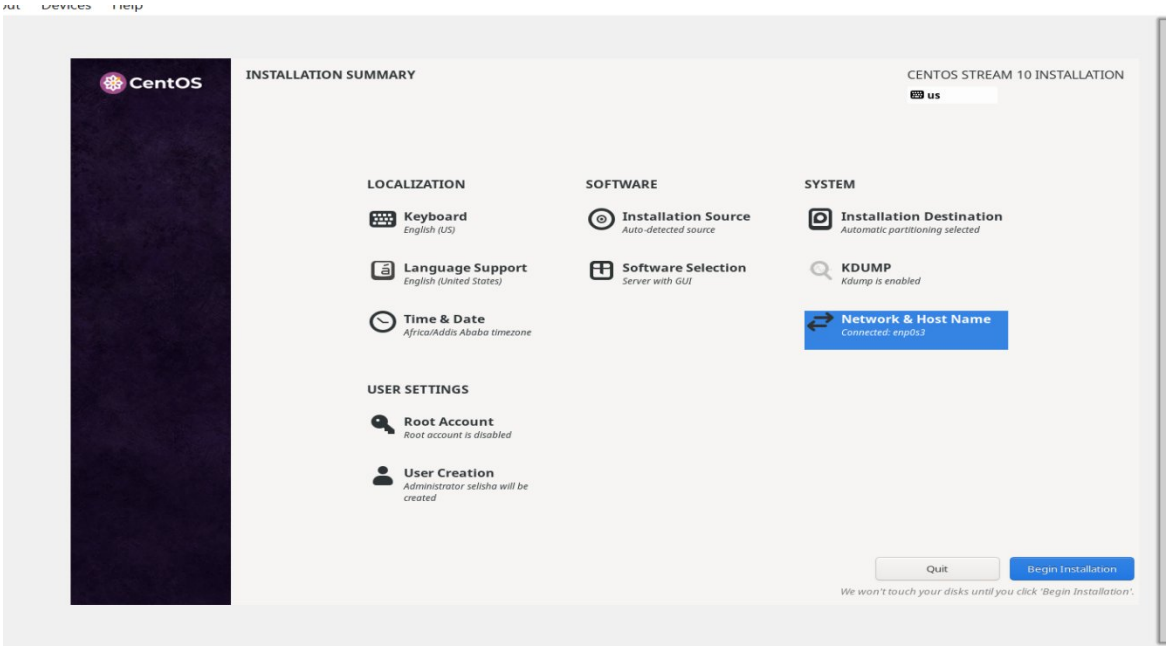

Figure 23: Installation summery screen

2. The installer will now copy files and configure the system.

3. The installation process may take several minutes depending on the allocated VM resources (RAM, CPU, disk).

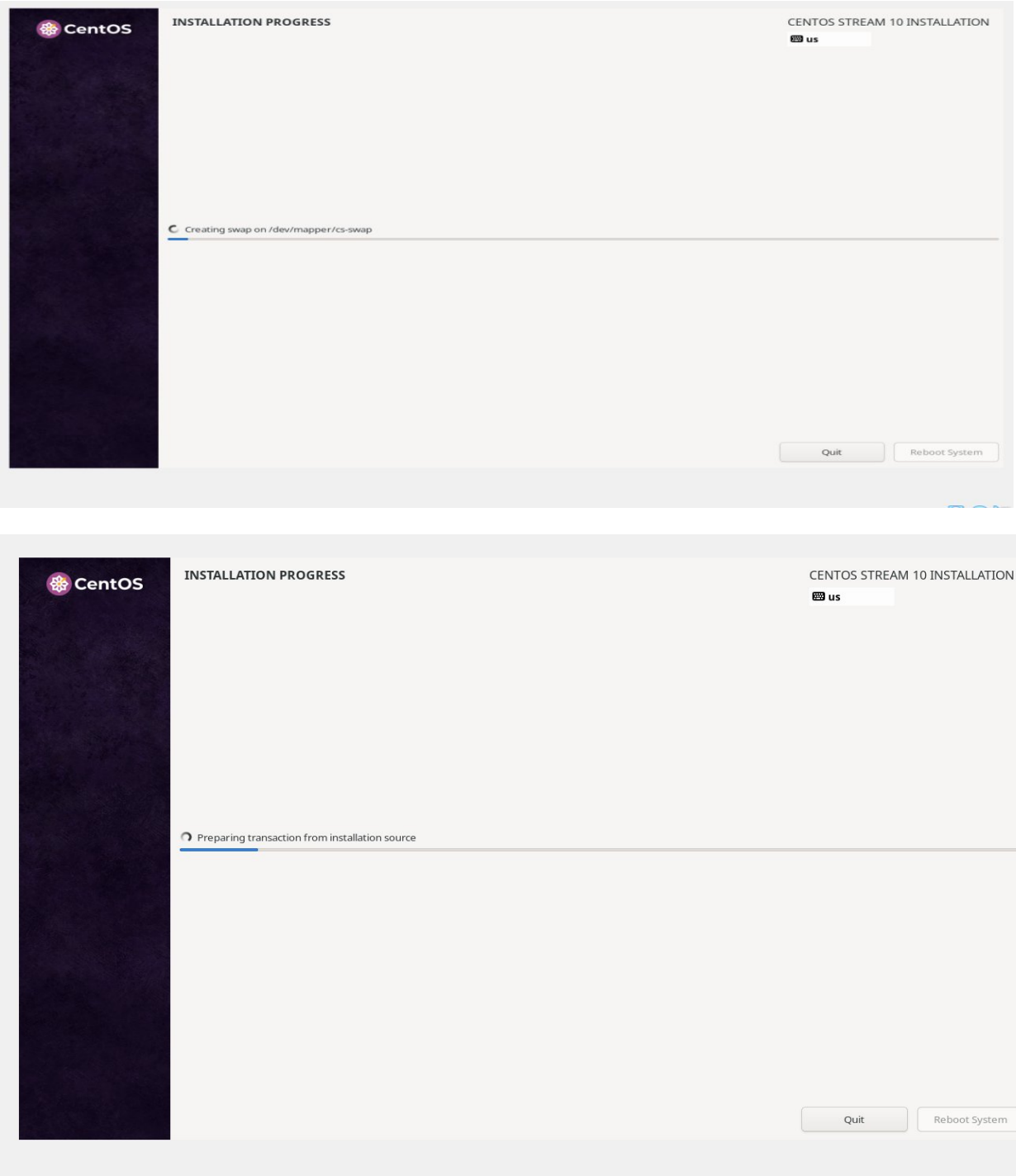

Figure 24: Installation Progress

Completion of Installation

1. Once the installation is finished, a message appears indicating that installation is complete.
2. Click Reboot to restart the virtual machine.

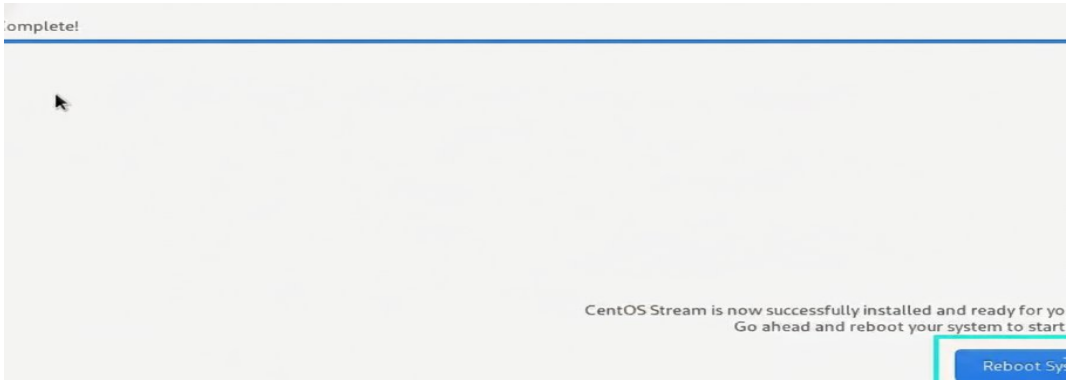

Figure 25: CentOS Stream installation completed message, prompting the user to reboot the virtual machine

3. During the first boot:
    - The VM will load CentOS Stream from the virtual hard disk.
    - Complete any first-time setup prompts if present (e.g., license agreement).

At this point, CentOS Stream 10 is fully installed and ready for use within the virtual environment.

Issues (Problems Faced)

1. Network Warning: During VirtualBox installation, the network was temporarily disconnected because new virtual network drivers were being installed. This is normal.

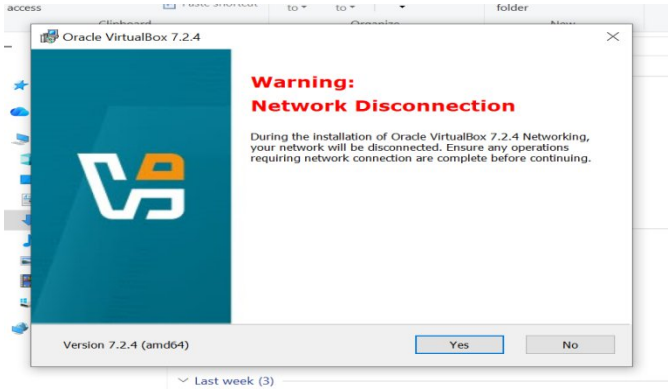

Figure 26:warning network disconnection screen

2. Slow ISO Boot: The virtual machine took some time to start from the CentOS ISO the first time.

Solution

The following solutions were applied to address the problems faced during installation:

1. Network Warning: No action was needed. The network returned automatically after installation of VirtualBox drivers.
2. Slow ISO Boot: Waited patiently for the virtual machine to finish booting; performance improved after the first boot

Filesystem Support (Simple Explanation)

NTFS

Used mainly by Windows.
Linux can read and write it, but it is not made for Linux systems.
✔ Good for sharing files with Windows
✕ Not good for installing CentOS Stre

FAT32

An old filesystem that works almost everywhere.
It cannot store large files and has no protection features.
✔ Good for USB flash drives
✕ Too weak for modern operating systems

exFAT

A newer version of FAT32 made for large files.
It works on many systems but has no data safety features.
✔ Good for external storage
✕ Not suitable for installing Linux

ext4

The main filesystem for Linux.
It is fast, stable, and protects data if the system crashes.
✔ Best choice for CentOS Stream
✔ Used in most Linux installations

Btrfs

A modern Linux filesystem with extra features.
It is powerful but more complex to manage.
✔ Good for advanced users
✕ Not ideal for beginners

ZFS

A very advanced filesystem used in servers.
It needs more memory and setup.

✔ Great for large servers
✕ Too heavy for this project

HFS+

Used by older Apple macOS systems.
Linux does not support it well.
✕ cannot be used for CentOS Stream

APFS

Used by new Apple macOS systems.
It only works on Apple devices.
✕ not supported on Linux

- ❖ Chose ext4 for CentOS because it works well with Linux, is fast, and won't cause problems if the system crashes

Advantages of Installing CentOS Stream in a Virtual Environment

- Safe environment: The operating system can be tested without affecting the host computer.
- Cost effective: No need to buy extra hardware.
- Easy testing: Multiple operating systems can run on one physical machine.
- Learning friendly: Ideal for practicing OS installation, configuration, and troubleshooting.
- Snapshot support: The system can be restored if something goes wrong.
- Hardware independence: Works on different PCs using the same virtual setup.

Disadvantages of Installing CentOS Stream in a Virtual Environment

- Lower performance: Virtual machines are slower than real hardware.
- Limited hardware access: Direct access to devices like GPUs is restricted.
- High resource usage: Requires enough RAM, CPU, and disk space from the host system.
- Depends on host OS: If the host system fails, the virtual machine also stops.
- Not fully real-world: Some hardware-level behaviors are different from physical systems.

Advantages of Using CentOS Stream

- Stable and reliable: Suitable for learning and development.
- Linux-based: Supports powerful command-line tools and server features.
- Regular updates: Receives continuous updates between major releases.
- Free and open source: No license cost.
- Enterprise oriented: Closely related to Red Hat Enterprise Linux.

Disadvantages of Using CentOS Stream

- Not beginner friendly: Requires Linux knowledge.
- Rolling updates: Changes may introduce instability if not managed well.
- Limited multimedia support: Requires extra configuration.
- Less desktop-focused: Designed more for servers and development.

Summary (One-line)

CentOS Stream in a virtual machine is excellent for learning and testing, but it cannot fully replace real hardware performance and requires basic Linux knowledge.

Conclusion

This project successfully demonstrated the installation of CentOS Stream in a virtual environment using Oracle VirtualBox. Through this task, the process of preparing a virtual machine, selecting appropriate system resources, choosing a suitable filesystem, and completing the operating system installation was clearly understood and applied.

The use of virtualization made it possible to install and test the operating system safely without affecting the host computer. Challenges faced during the installation were minimal and helped improve troubleshooting and problem-solving skills. The ext4 filesystem was selected because it is stable, reliable, and well suited for Linux-based operating systems.

Overall, this project provided practical experience with operating system installation and virtualization technology. It strengthened understanding of how operating systems interact with hardware and software in real-world environments and prepared the learner for future system administration and technical tasks.

Future Outlook / Recommendation

In the future, the skills gained from this project can be expanded by installing and testing other Linux distributions and operating systems in virtual environments. This will help improve understanding of different installation methods, system configurations, and performance differences.

It is recommended to explore advanced virtualization features such as snapshots, shared folders, and network configurations to gain deeper practical experience. Learning to allocate system resources more efficiently will also help improve virtual machine performance.

Additionally, practicing installations on real hardware can further strengthen system administration skills and provide exposure to hardware-level configurations. Regular updates and basic security configurations are also recommended to maintain system stability and safety.

Overall, continued practice with virtualization and operating system management will better prepare students for real-world technical and professional environments.

Virtualization in Modern Operating Systems

What is Virtualization?

Virtualization lets you run more than one OS on the same computer. Each OS runs in its own safe box called a virtual machine. Each operating system runs inside its own virtual machine (VM), which works like a real computer but uses the same hardware as the host computer.

Why Virtualization is used?

Virtualization is used because it:

- Saves hardware costs: Multiple systems can run on one computer.
- Provides safety: Testing or experimenting in a VM does not affect the main system.
- Supports learning and practice: Students can install and explore different operating systems safely.
- Improves efficiency: Hardware resources like CPU, memory, and storage are used better.
- Adds flexibility: Different operating systems and software can run together on one machine.

How Virtualization Works?

Virtualization works through a hypervisor, which is a software layer that sits between the physical computer and the virtual machines.

- The hypervisor divides the computer's resources (CPU, memory, storage, network) among virtual machines.
- Each VM gets its own portion of resources and runs its own operating system independently.
- The host system continues to run normally while VMs operate alongside it.

Examples of virtualization software used in this project include Oracle VirtualBox and VMware Workstation.

Virtualization allows multiple operating systems to run safely and efficiently on one computer. It is very useful for learning, testing, development, and managing systems without needing extra hardware.