

System Administration (2)

IT401

Prepared by
Dr. Ahmed El-Douh

Lecture 2



System Administration 2

Lecture 2

IT401

Introduction to Linux & System Architecture

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Objectives

Upon completion of this lecture, you will be able to:

- Understand systems, services, and the role of system administration in organizations.
- Learn key responsibilities, tools, and challenges of system administrators.
- Apply best practices, rules, and ethics in system management.

Outlines

- Comparing User Interfaces: CLI vs. GUI
- Introduction to the Linux Operating System
- Linux Distribution
- Linux Terminology
- The Linux Command Line Environment
- Installing Linux in a Virtual Machine
- Fundamental Linux Commands

Chapter
02

Comparing User Interfaces: CLI vs. GUI



CLI vs GUI

 **CLI: Command Line Interface** allows users to interact with the computer using text commands.

 **GUI: Graphical User Interface** enables interaction through graphical elements like windows, icons, and menus.

✓ Both have their use cases in modern computing.

CLI vs GUI

>_ Command Line Interface (CLI)

-  **Text-based:** Requires knowledge of specific commands and syntax
-  **Performance:** Fast and lightweight, uses minimal system resources
-  **Automation:** Scriptable and powerful for batch processing
-  **Remote work:** Ideal for remote server administration
-  **Learning curve:** Steeper learning curve, requires memorization
-  **Efficiency:** More efficient for power users and experienced admins

🖥️ Graphical User Interface (GUI)

-  **Visual:** Intuitive interaction through graphical elements
-  **Resources:** More resource-intensive, requires graphics rendering
-  **Accessibility:** Beginner-friendly with visual cues and feedback
-  **Visual tasks:** Better for design, browsing, and multimedia work
-  **Adoption:** Easier to learn and use for most computer users
-  **Environment:** Suitable for everyday desktop use and multitasking

When to Use CLI vs GUI

> When to Use CLI

-  **System Administration** - Managing remote servers without graphical interface
-  **Automation** - Creating scripts for repetitive tasks and batch processing
-  **Performance** - Working on systems with limited resources
-  **Development** - Git operations, compilation, and deployment processes
-  **Data Processing** - Handling large datasets with tools like grep, awk, sed

🖥️ When to Use GUI

-  **Creative Work** - Graphic design, video editing, and content creation
-  **Data Visualization** - Viewing and interacting with graphs and charts
-  **Web Browsing** - Everyday internet use and multimedia consumption
-  **User Training** - Teaching beginners who need visual cues
-  **Entertainment** - Gaming and media consumption

Chapter
02

Introduction to the Linux Operating System



What is Linux?

- **Linux** is an open-source operating system **kernel** that serves as the foundation for many different operating system distributions. Created by **Linus Torvalds** in **1991**.
- **Linux** is based on **Unix** principles and has become one of the most widely used operating systems in the world.
- Open-source software meaning anyone can view, modify, and distribute its source code.



What is Linux?

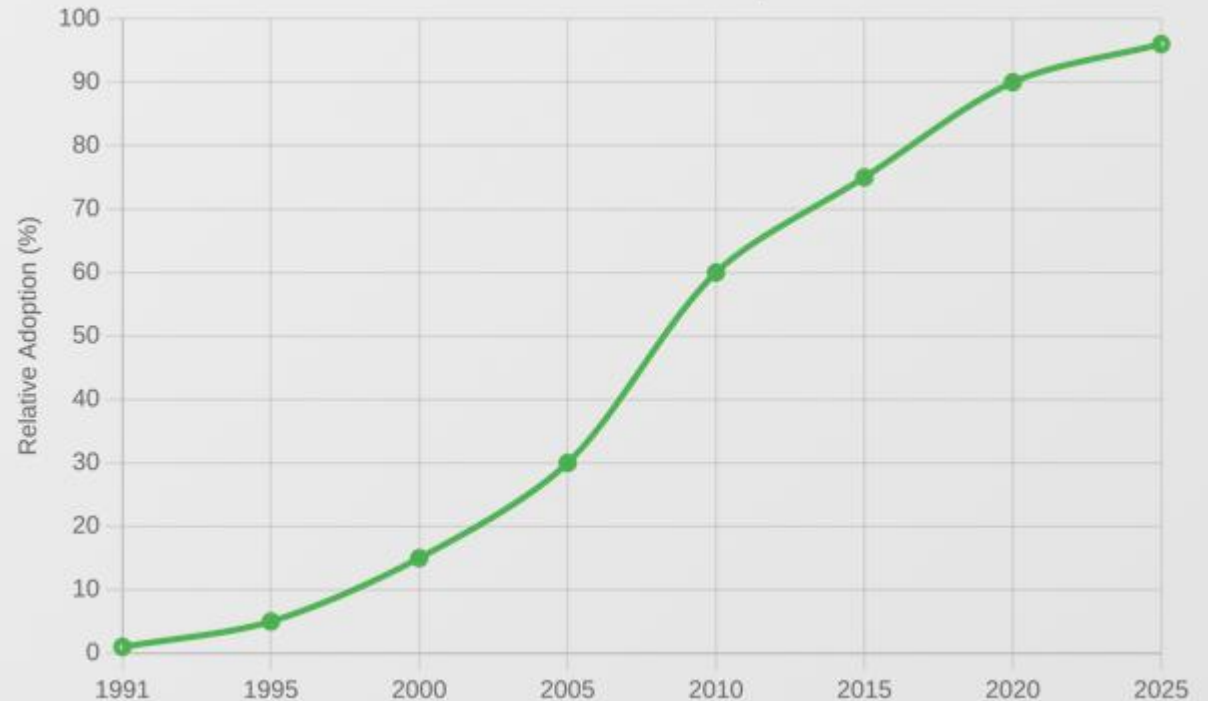
- ❑ **Linux** is a "**Unix-like**" operating system that was created from scratch to be a **free** and **open-source** alternative to the proprietary Unix systems.
- ❑ **Linux** is the modern, open-source re-implementation of those ideas, which made the power of a Unix-like system accessible to everyone.



A Brief History

- **1983:** Richard Stallman announces the GNU Project to create a free Unix-like operating system
- **1991:** Linus Torvalds, a Finnish student, begins working on a new kernel as a hobby project
- **1992:** Linux is released under the GNU General Public License (GPL)
- **1993:** Over 100 developers begin contributing to Linux development
- **1994:** First major Linux distribution, Slackware, is released
- **1996:** Tux the penguin becomes the official Linux mascot
- **2025:** Linux powers millions of devices worldwide, from smartphones to supercomputers

Linux Growth and Adoption



Linux Key Features



Stability & Reliability

Exceptional uptime and resistance to crashes, making it ideal for critical systems



Security

Robust permission system and fewer vulnerabilities compared to other operating systems



Flexibility & Customization

Highly adaptable to various needs, from embedded devices to supercomputers

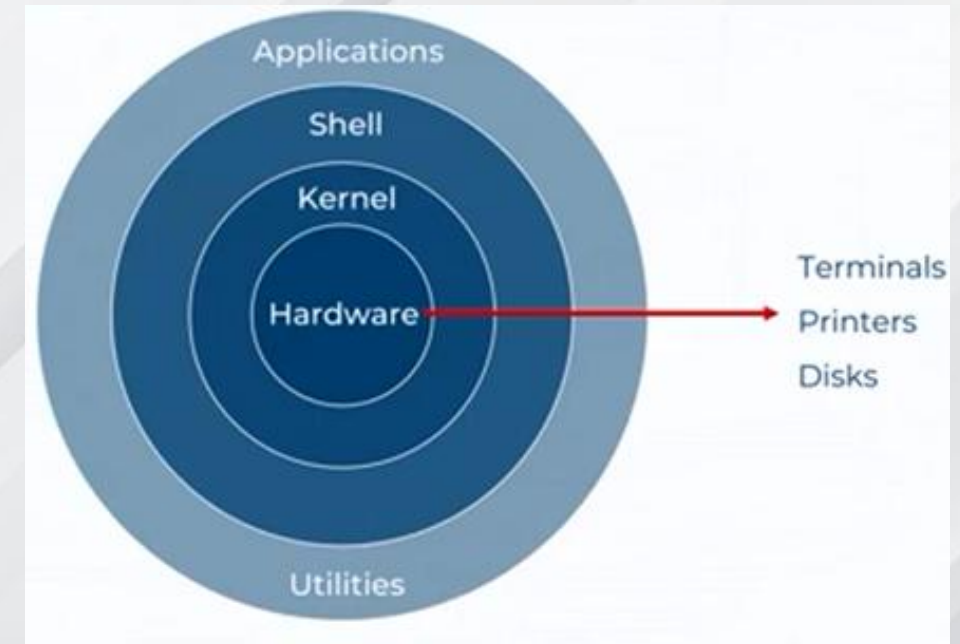


Open Source

Community-driven development with transparent code and collaborative improvement

Linux Architecture

Linux follows a **layered architecture** design where each layer provides specific services to the layers above it.



Linux Architecture

❑ Kernel

The core of Linux that interfaces directly with hardware. Manages memory, processes, devices, and system calls.

❑ Shell

Command interpreter that provides an interface between the user and the kernel. Executes commands and scripts.

❑ Application Layer

User applications, system utilities, and daemons (background services) that run on top of the shell and kernel.

❑ Hardware Interaction

The kernel manages hardware resources through schedulers, memory management, and device drivers.

What is kernel?

A good way to understand the **kernel** is to think of it as the **brain** of the operating system. It manages all the essential, low-level operations that you rarely see but that are **critical** for the computer to function.

Just as your brain coordinates all your body's functions without you consciously thinking about it, the kernel manages the computer's resources behind the scenes.

What is kernel?

The **kernel** is the core component of an operating system that acts as a bridge between applications and the computer's hardware. It's the most fundamental part of the OS that manages system resources and provides essential services.

Key Functions of the Kernel

- ☐ Hardware Management
- ☐ Resource Allocation
- ☐ Process Management
- ☐ Memory Management
- ☐ Security and Access Control
- ☐ System Calls



Chapter
02

Linux Distribution



Definition of Linux Distribution

❑ What is a Linux Distribution?

- **Definition:** A Linux distribution is an operating system based on the Linux kernel, including a collection of software.
- **Components:** Kernel, package manager, desktop environment, utilities.

"A Linux distribution is a version of Linux that bundles the Linux kernel with additional software, providing a complete operating system."

Linux Distributions



Linux Distributions

- Over **600** active Linux distributions exist today

Popular Distributions



Ubuntu

User-friendly, great for beginners



Fedora

Cutting-edge features, developer-focused



Debian

Stable, reliable, community-driven



Linux Mint

Elegant, modern, easy to use



Arch Linux

Lightweight, flexible, DIY approach



Red Hat Enterprise Linux

Enterprise-grade, commercial support

Major Linux Distributions

❑ Why Are There So Many Distributions?

- **Customization**: Different distros are optimized for different tasks (e.g., servers, desktops).
- **Community**: Each distribution has a dedicated community with different goals and focuses.

"Linux distributions are numerous because they serve **different purposes and communities**, whether for servers, desktops, or specialized use cases."

Categories of Distributions

□ Categories of Linux Distributions:

- **General-Purpose:** Ubuntu, Fedora, openSUSE.
- **Enterprise:** Red Hat Enterprise Linux (RHEL), SUSE Linux Enterprise.
- **Minimalist:** Arch Linux, Gentoo.
- **Specialized:** Kali Linux (security), Raspberry Pi OS (embedded systems).

"Linux distros can be classified based on their use cases, from **general-purpose** to **specialized for specific tasks** like security or embedded systems."

Chapter
02

Linux Terminology



Linux Terminology

The **terminal** is the program that provides a **text-based** interface window where you can **type** commands. It's essentially a text input/output environment that displays a command prompt and shows the results of commands you run. Think of it as the "window" or "screen" where you interact with the system through text.

Linux Terminology

The **shell** is the command interpreter program that actually processes the commands you type in the terminal. When you type a command, the shell **reads** it, **interprets** what you want to do, executes the appropriate programs, and **returns** the results. The shell acts as an **intermediary** between you and the operating system kernel. It handles things like command parsing, variable expansion, and running programs.

Linux Terminology

Bash (Bourne Again Shell) is a specific type of shell - arguably the most popular and widely-used shell in Linux systems. It's the default shell on most Linux distributions. Bash includes features like command history, tab completion, scripting capabilities, and various built-in commands. Other shells include zsh, fish, dash, and the original Bourne shell (sh).

Linux Terminology

Common Linux Shells

- › **Bash** (Bourne Again Shell) - Default on most Linux distributions
- › **Zsh** - Extended Bourne shell with improved features and themes
- › **Fish** - User-friendly shell with autosuggestions
- › **Dash** - Lightweight shell optimized for speed

Terminal Emulators

- › **GNOME Terminal** - Default for GNOME desktop environment
- › **Konsole** - KDE's terminal emulator
- › **xterm** - Standard terminal emulator for X Window System
- › **Alacritty** - GPU-accelerated terminal emulator

Linux Terminology

How They Work Together:

1. You open a **terminal** application.
2. The **terminal** starts a **shell** program, which is usually **Bash** by default
3. You **type** a command into the terminal.
4. The shell (Bash) **interprets** the command and tells the operating system what to do.
5. The output of the command is then **displayed** back to you in the terminal window.

Linux Account: **Root Account**

- **Superuser:** Has complete administrative control over the system
- **User ID (UID):** Always **0**
- **Privileges:** Can access all files, modify system configurations, install/remove software, manage other users, and perform any system operation
- **Prompt:** Typically shows **#** symbol
- **Home directory:** Usually **/root**
- **Risk:** Commands run as root can potentially damage or compromise the entire system

Linux Account: Regular User Account

- **Limited privileges:** Can only access their own files and perform non-administrative tasks
- **User ID (UID):** Typically, **1000** and above for regular users
- **Restrictions:** Cannot modify system files, install system-wide software, or access other users' private files without permission
- **Prompt:** Typically shows **\$** symbol
- **Home directory:** Usually **/home/username**
- **Safety:** Mistakes are generally contained to the user's own files and space

Chapter

02

The Linux Command Line Environment



Exploring Linux Distributions

Prerequisites To Install Red Hat Enterprise Linux On VMWare Workstation

RHEL 9 ISO image:

- ❑ To download RHEL 9 for free, use following portal
[Red Hat Enterprise Linux product](#)

VMWare Workstation:

- ❑ To download VMWare Workstation, use following portal
[VMWare Workstation](#)

Ensure that hardware virtualization support is turned on in the BIOS settings



Chapter
02

Virtual Machine:



VMware Workstation Pro 17: Creating a New Virtual Machine

WORKSTATION PRO™ 17



Create a New
Virtual Machine



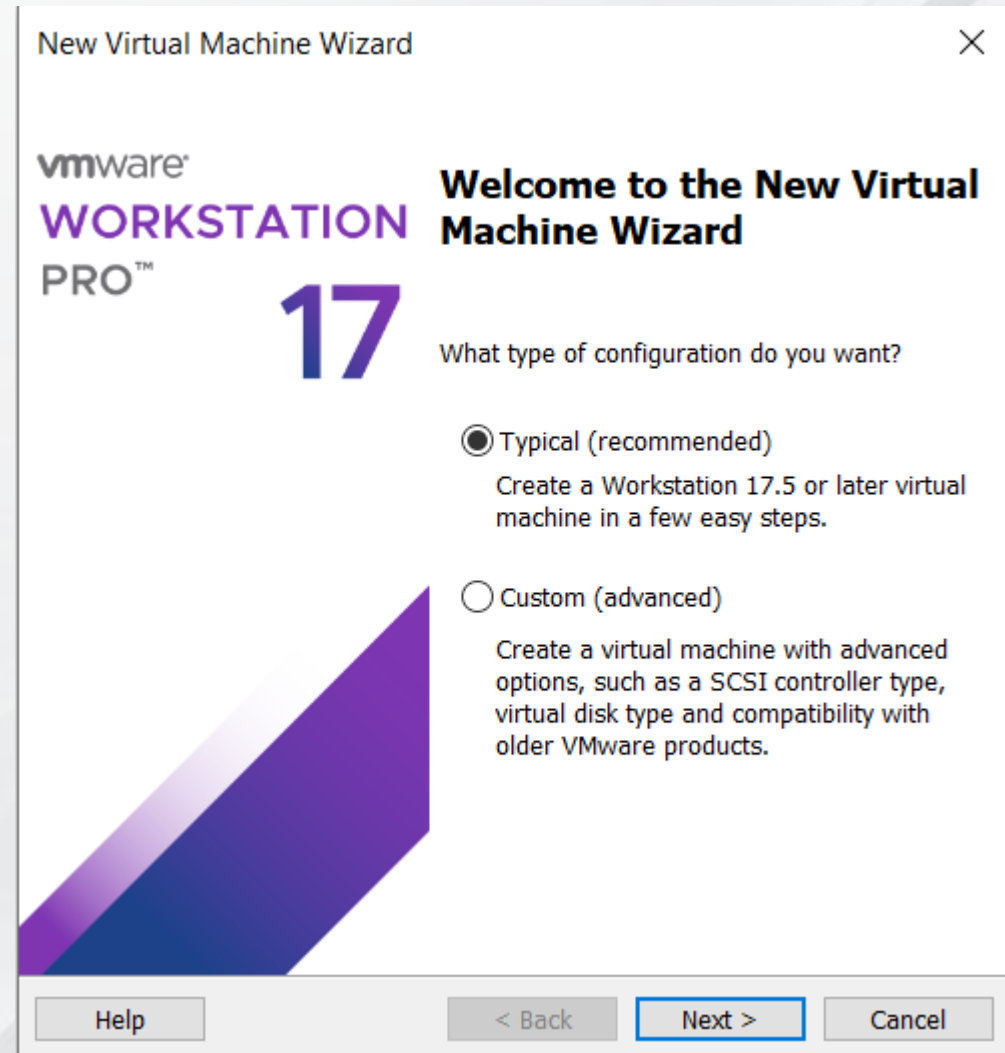
Open a Virtual
Machine



Connect to a
Remote Server

Creating a New Virtual Machine

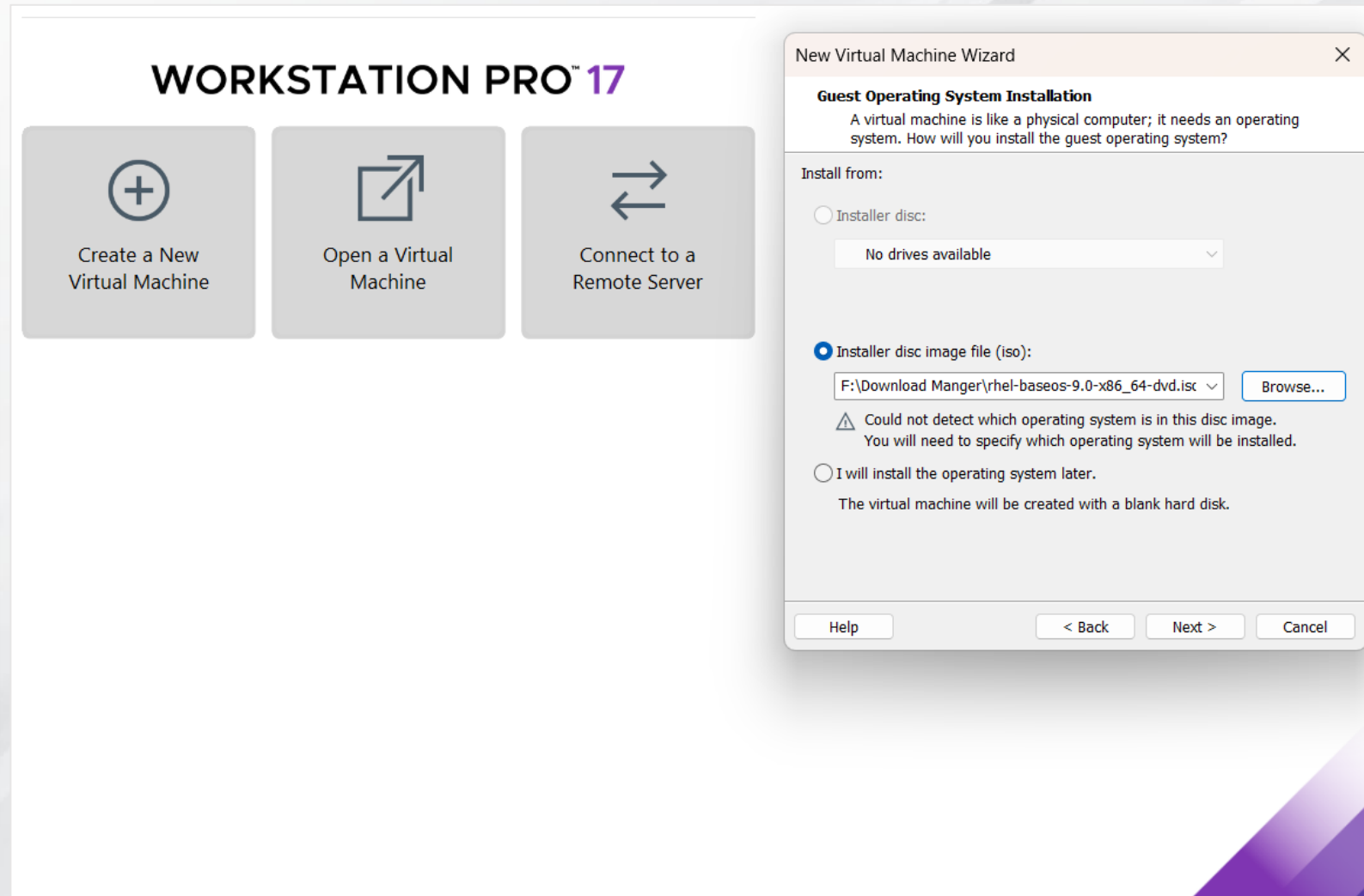
Select Typical



Creating a New Virtual Machine: Red Hat Enterprise Linux

Select **Browse**

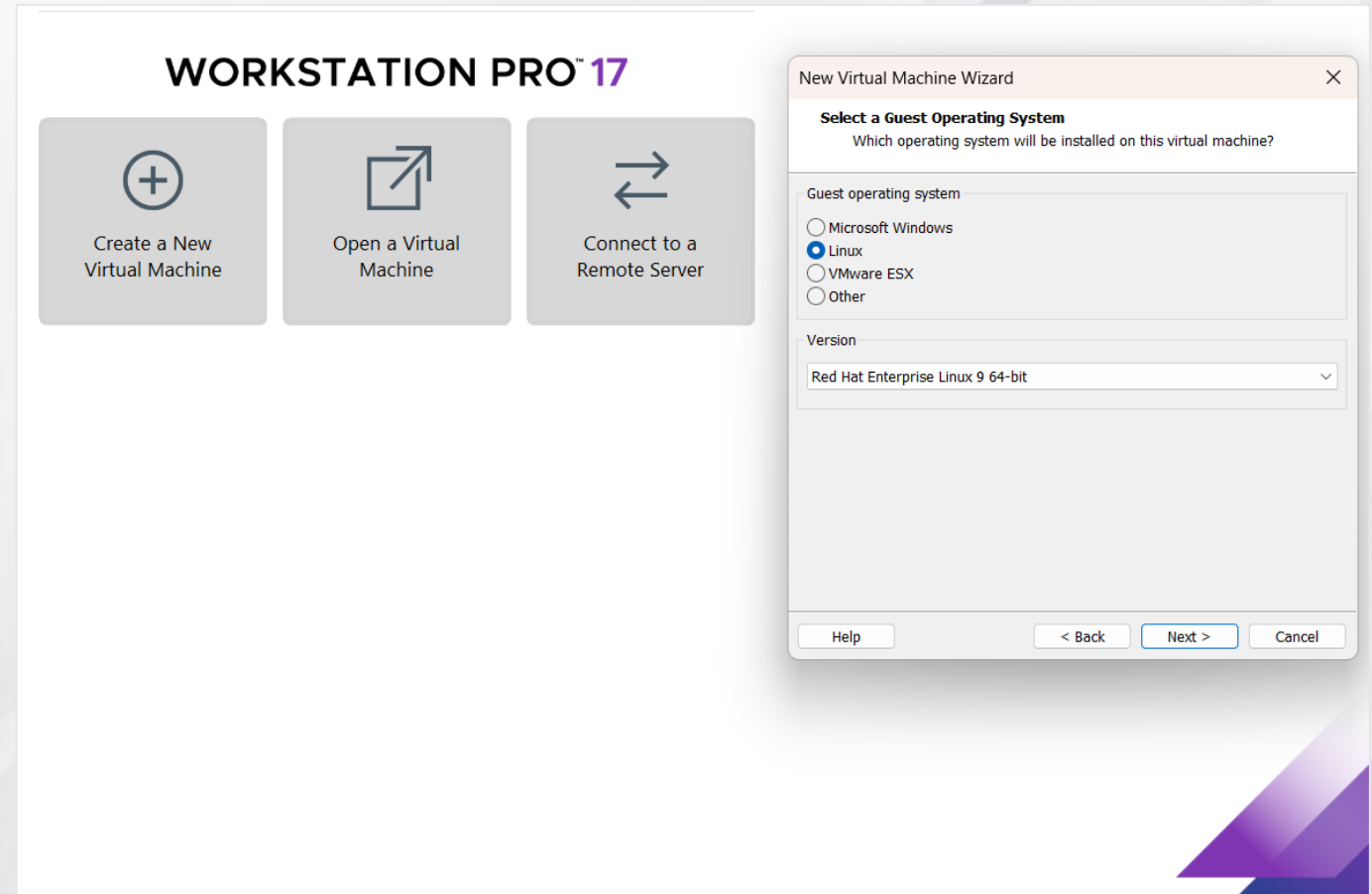
Select **Iso File** for **Red Hat**



Creating a New Virtual Machine: Red Hat Enterprise Linux

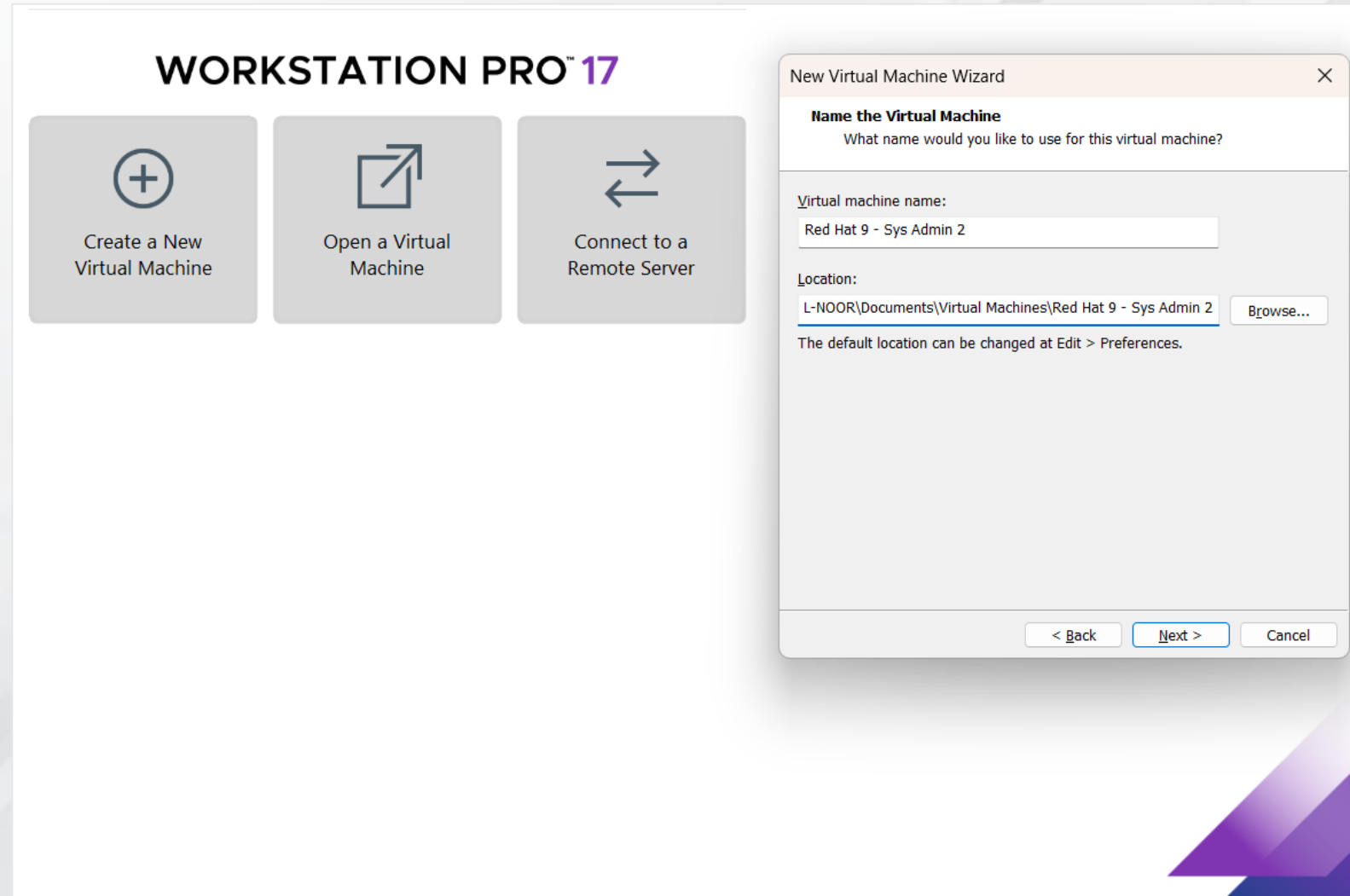
Select **Linux**

Version: **Red Hat Enterprise Linux 9**



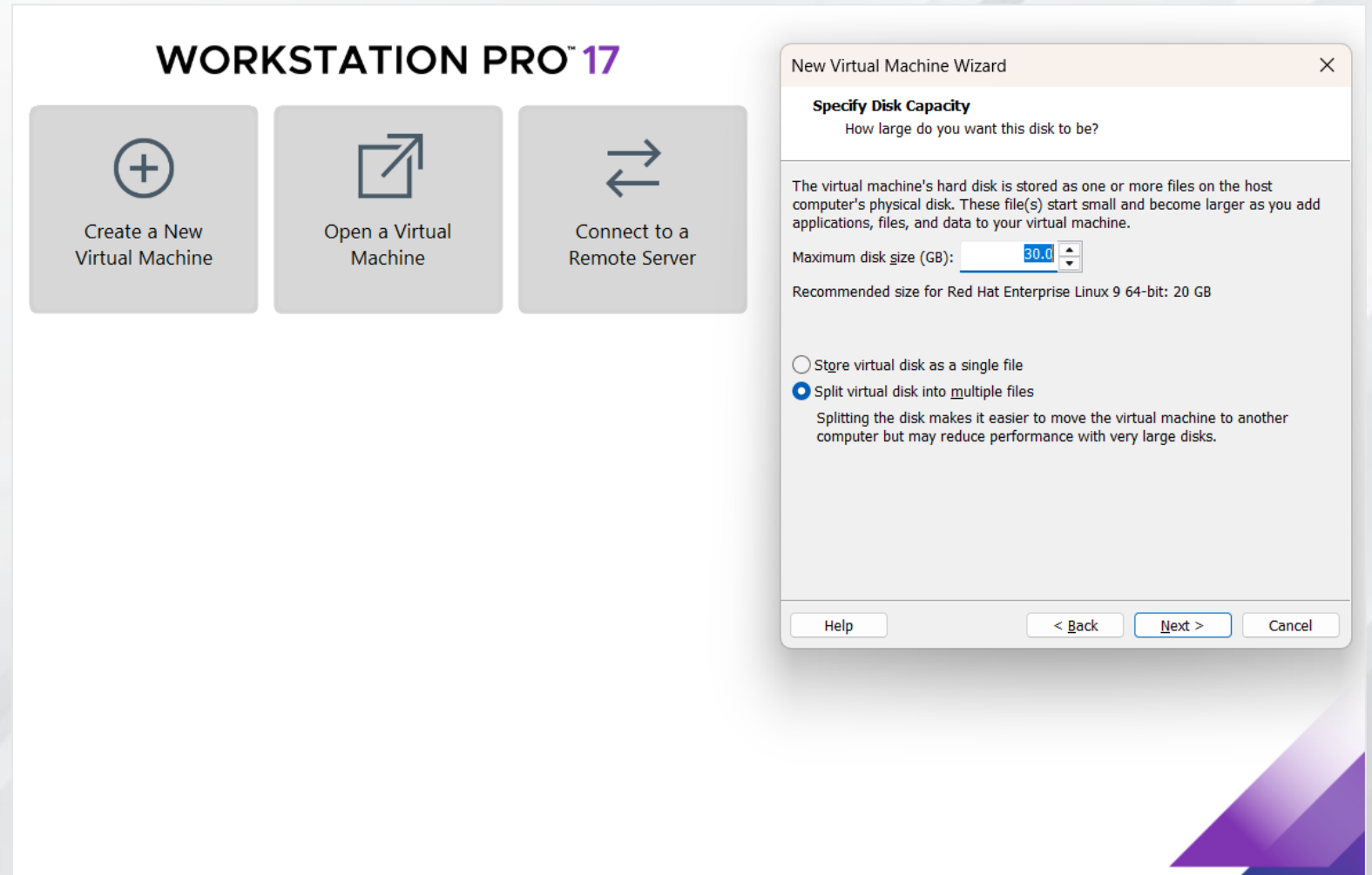
Creating a New Virtual Machine: Red Hat Enterprise Linux

Click the “**Next**” button



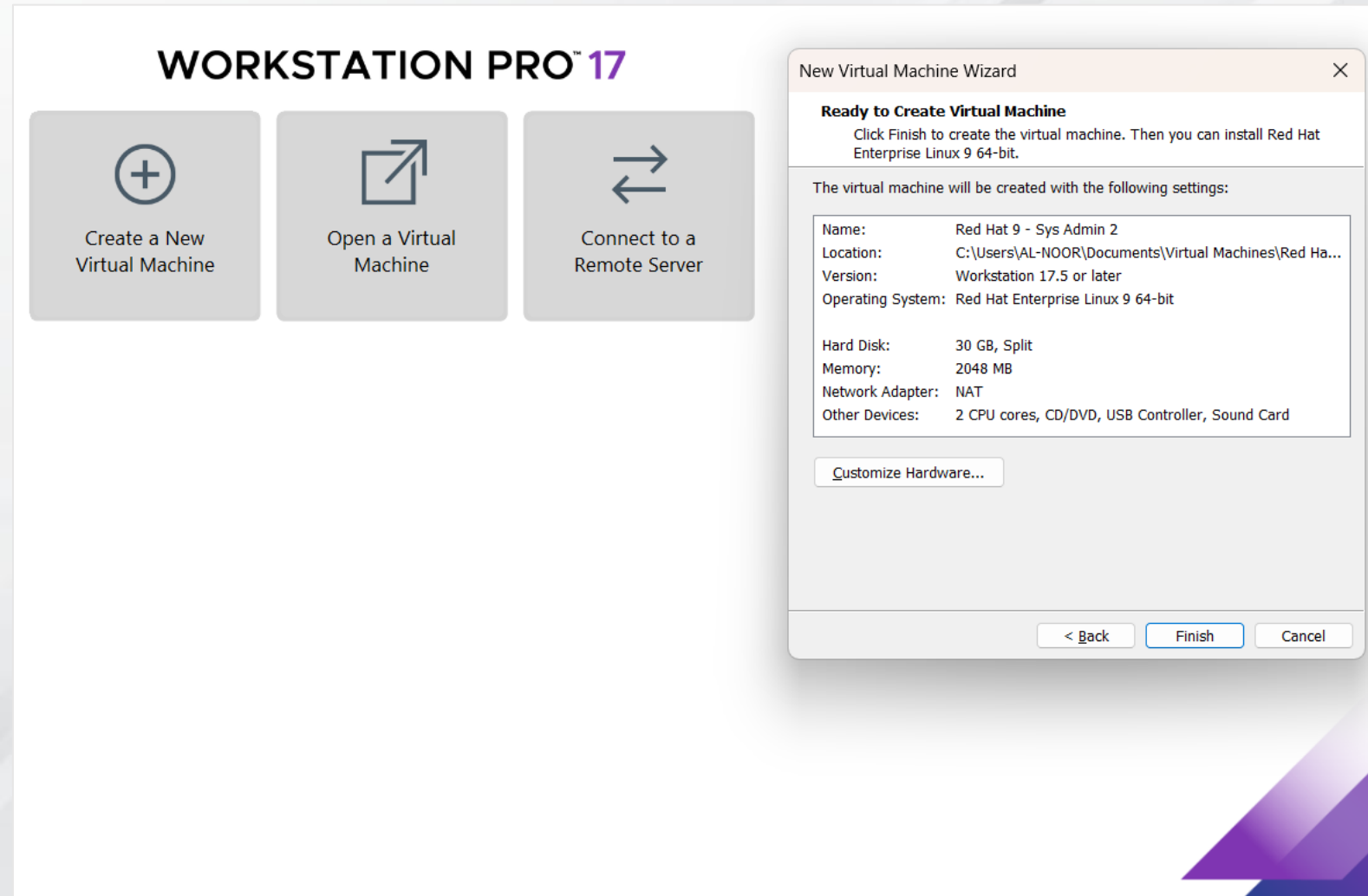
Creating a New Virtual Machine: Red Hat Enterprise Linux

Choose your Suitable **Size**
and click **"Next"**



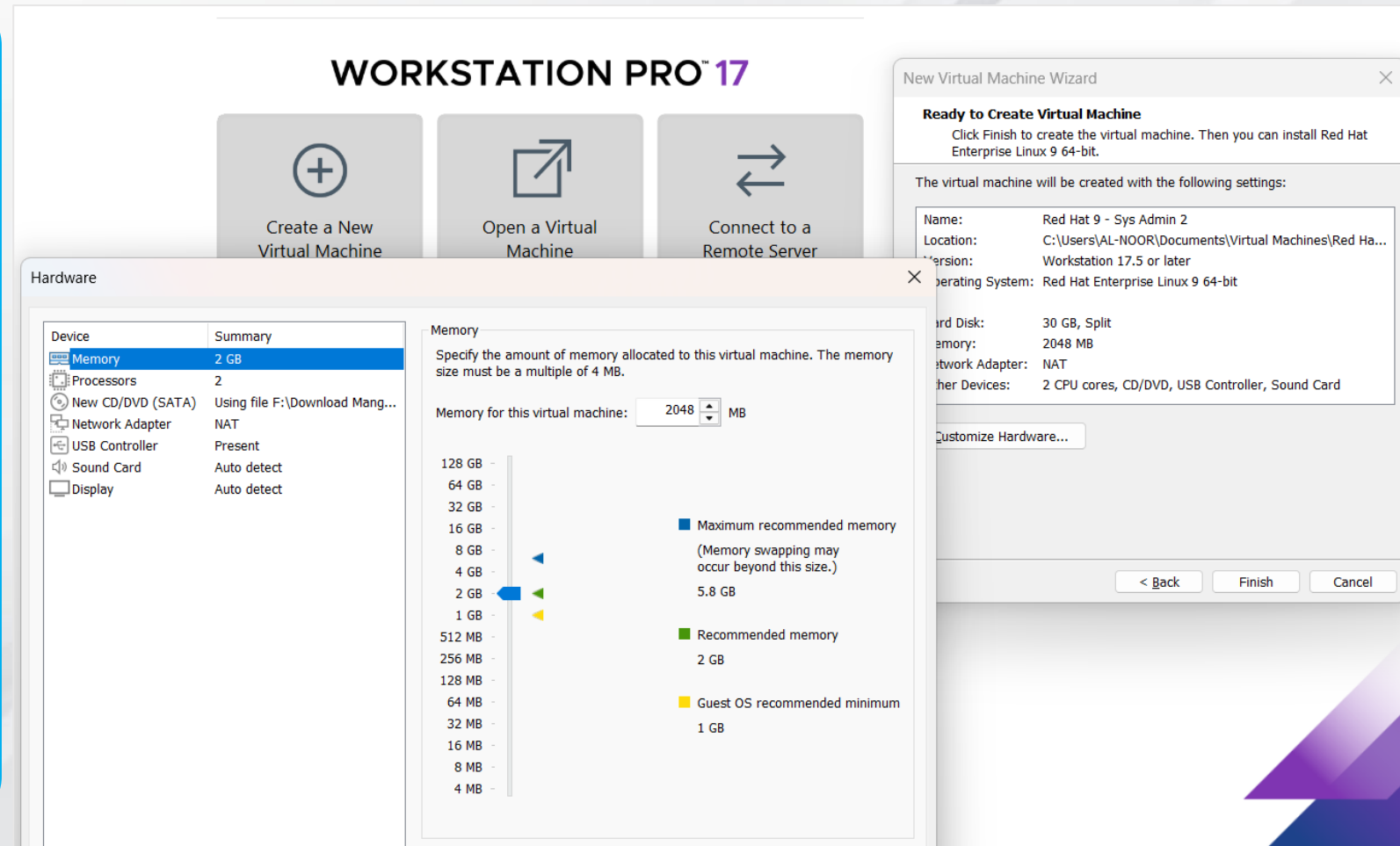
Creating a New Virtual Machine: Red Hat Enterprise Linux

Here are the
VM specifications



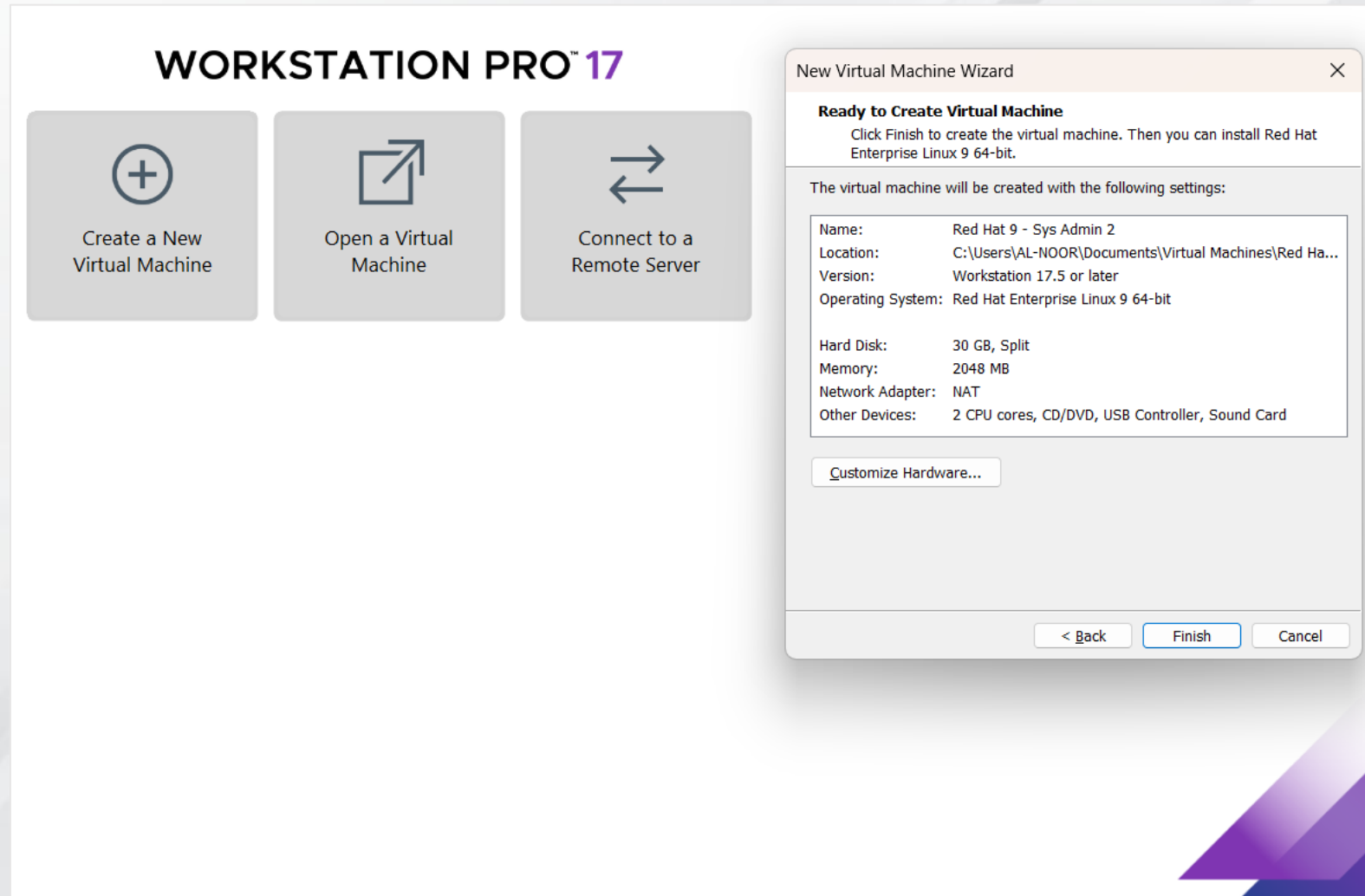
Creating a New Virtual Machine: Red Hat Enterprise Linux

Adjust **memory** and processors as required, then proceed
At least 2 GB RAM is needed



Creating a New Virtual Machine: Red Hat Enterprise Linux

Click **Finish**



Chapter
02

Installation of RHEL 9



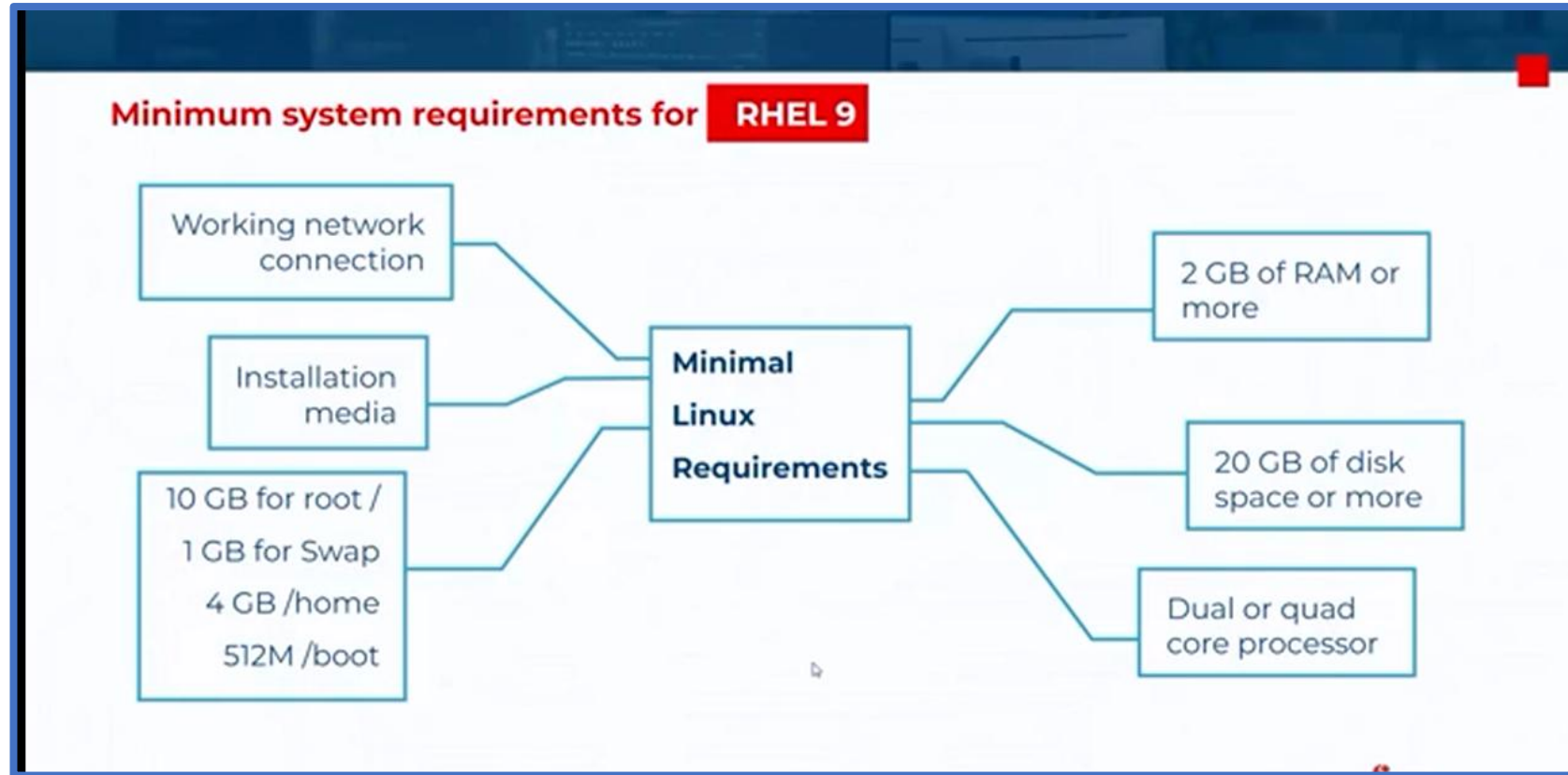
Red Hat Enterprise Linux (RHEL)

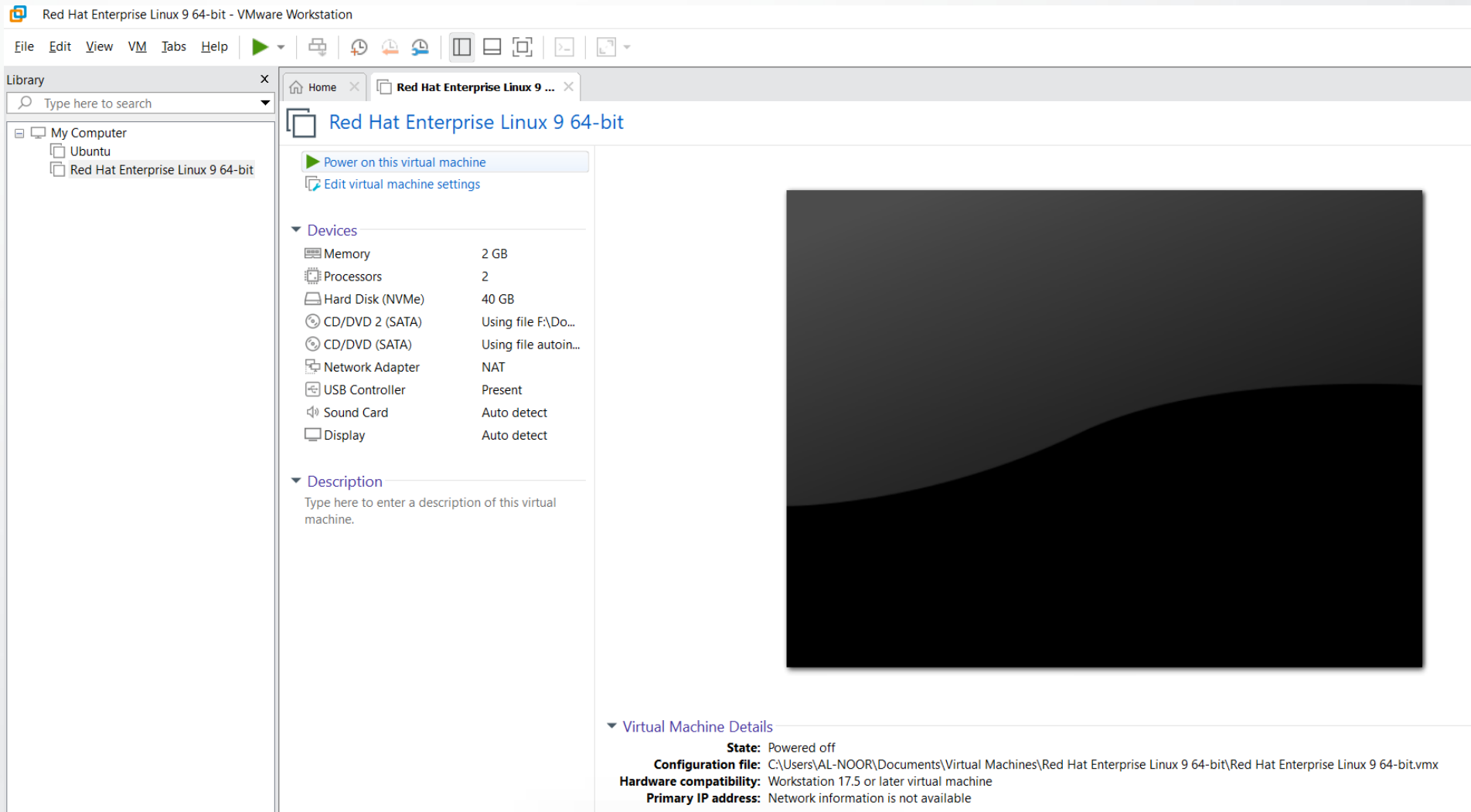
WHO IS RED HAT?

- ❑ Red Hat is the world's leading provider of open-source software solutions, using a community powered approach to reliable and high-performance cloud, Linux, middleware, storage, and virtualization technologies.
- ❑ Red Hat's mission is to be the catalyst in communities of customers, contributors, and partners creating better technology the open source way.



Red Hat Enterprise Linux (RHEL)

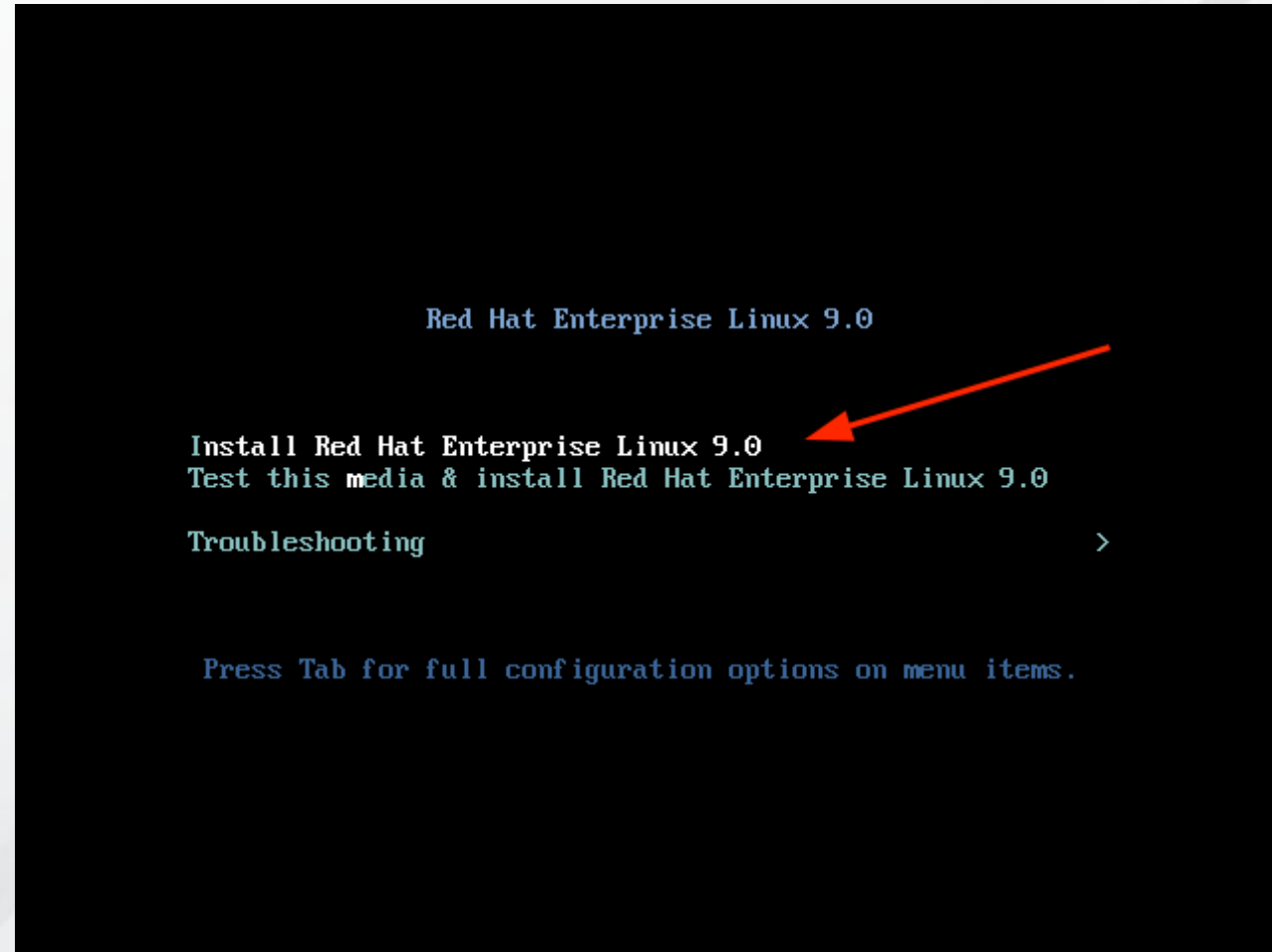




Click Power On

- **Step 1: Start RHEL 9 Installation**

- When the system reboots, you will get a black screen with the following options. To begin the installation, press **ENTER** on the first option 'Install Red Hat Enterprise Linux 9.0'.





RED HAT ENTERPRISE LINUX 9.0 INSTALLATION

us

Help!

WELCOME TO RED HAT ENTERPRISE LINUX 9.0.

What language would you like to use during the installation process?

English	English >	English (United States)
Français	French	English (United Kingdom)
Deutsch	German	English (India)
日本語	Japanese	English (Australia)
中文	Mandarin Chin...	English (Canada)
Русский	Russian	English (Denmark)
Español	Spanish	English (Ireland)
Afrikaans	Afrikaans	English (New Zealand)
অসমীয়া	Assamese	English (Nigeria)
		English (Hong Kong SAR China)
		English (Philippines)

Type here to search. ✕

Quit

Continue



- Step 2: Configure Partitioning



INSTALLATION SUMMARY

RED HAT ENTERPRISE LINUX 9.0 INSTALLATION

us [Help!](#)

LOCALIZATION


Keyboard
English (US)


Language Support
English (United States)


Time & Date
Africa/Nairobi timezone

USER SETTINGS


Root Password
Root account is disabled

SOFTWARE


Connect to Red Hat
Not registered.


Installation Source
Local media


Software Selection
Server with GUI

SYSTEM


Installation Destination
Automatic partitioning


KDUMP
Kdump is enabled


Network & Host Name
Wired (enp0s3) connected


Security Profile
No profile selected

Quit

Begin Installation

We won't touch your disks until you click 'Begin Installation'.

 Please complete items marked with this icon before continuing to the next step.

INSTALLATION DESTINATION

Done

RED HAT ENTERPRISE LINUX 9.0 INSTALLATION

us

Help!

Device Selection

Select the device(s) you'd like to install to. They will be left untouched until you click on the main menu's "Begin Installation" button.

Local Standard Disks

30 GiB



VMware Virtual NVMe Disk
nvme0n1 / 30 GiB free

Disks left unselected here will not be touched.

Specialized & Network Disks



Add a disk...

Disks left unselected here will not be touched.

Storage Configuration

☒ Automatic ☐ Custom

☐ I would like to make additional space available.

Encryption

☐ Encrypt my data. *You'll set a passphrase next.*

[Full disk summary and boot loader...](#)

1 disk selected; 30 GiB capacity; 30 GiB free [Refresh...](#)

Click Done



Red Hat



INSTALLATION SUMMARY

RED HAT ENTERPRISE LINUX 9.0 INSTALLATION

 **us**

[Help!](#)

LOCALIZATION



Keyboard
English (US)



Language Support
English (United States)



Time & Date
Asia/Baghdad timezone

USER SETTINGS



Root Password
Root account is disabled



User Creation
No user will be created

SOFTWARE



Connect to Red Hat
Not registered.



Installation Source
Local media



Software Selection
Server with GUI

SYSTEM



Installation Destination
Automatic partitioning selected



KDUMP
Kdump is enabled



Network & Host Name
Wired (ens160) connected



Security Profile
No profile selected

Quit

Begin Installation

We won't touch your disks until you click 'Begin Installation'.

 Please complete items marked with this icon before continuing to the next step.

Wired (enp0s3) connected



Security Profile

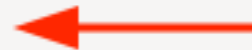
No profile selected

USER SETTINGS



Root Password

Root account is disabled



User Creation

No user will be created

Quit

Begin Installation

We won't touch your disks until you click 'Begin Installation'.



Please complete items marked with this icon before continuing to the next step



Red Hat

ROOT PASSWORD

RED HAT ENTERPRISE LINUX 9.0 INSTALLATION

Done



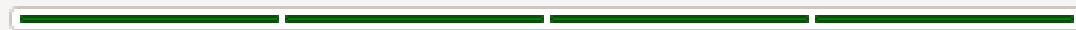
 us

Help!

The root account is used for administering the system. Enter a password for the root user.

Root Password:

●●●●●●●●●●●●●●●●



Strong

Confirm:

●●●●●●●●●●●●●●●●



☐ Lock root account

☐ Allow root SSH login with password

USER SETTINGS



Root Password

Root password is set



User Creation

No user will be created



Security Profile

No profile selected

Quit

Begin Installation

We won't touch your disks until you click 'Begin Installation'.



Red Hat

CREATE USERRED HAT ENTERPRISE LINUX 9.0 INSTALLATION

Done

us

Help!

Full name

tecmin

User name

tecmin

☐ Make this user administrator

☒ Require a password to use this account

Password

••••••••••

👁

Strong

Confirm password

••••••••••

👁

Advanced...

 **Time & Date**
Africa/Nairobi timezone

 **Software Selection**
Server with GUI

 **Network & Host Name**
Wired (enp0s3) connected

 **Security Profile**
No profile selected

USER SETTINGS

 **Root Password**
Root password is set

 **User Creation**
User tecmint will be created

Quit

Begin Installation

We won't touch your disks until you click 'Begin Installation'.



INSTALLATION PROGRESS

RED HAT ENTERPRISE LINUX 9.0 INSTALLATION





 Downloading packages

Quit

Reboot System





INSTALLATION PROGRESS

RED HAT ENTERPRISE LINUX 9.0 INSTALLATION

 `us`

Complete!

Red Hat Enterprise Linux is now successfully installed and ready for you to use!
Go ahead and reboot your system to start using it!



Reboot System

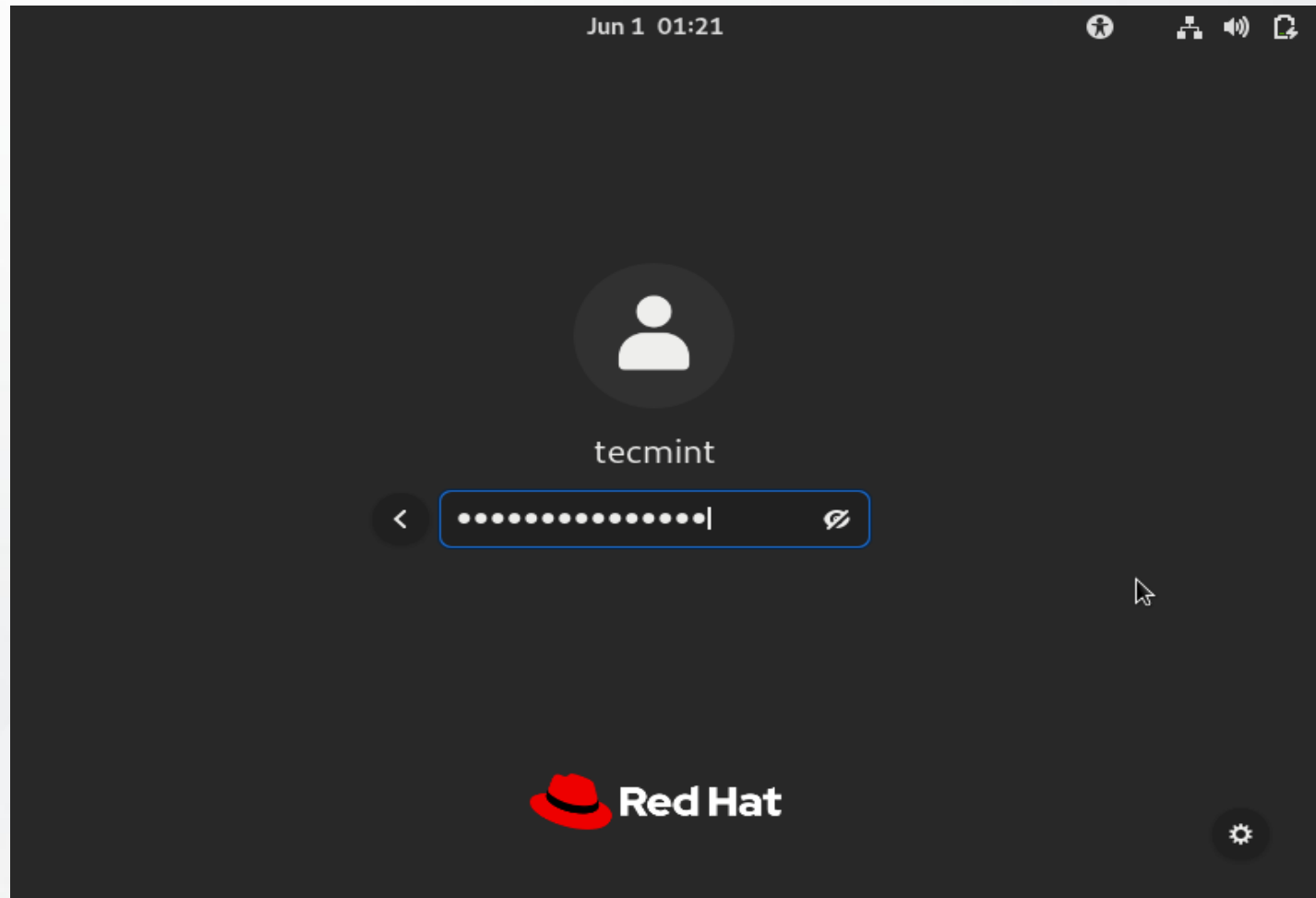


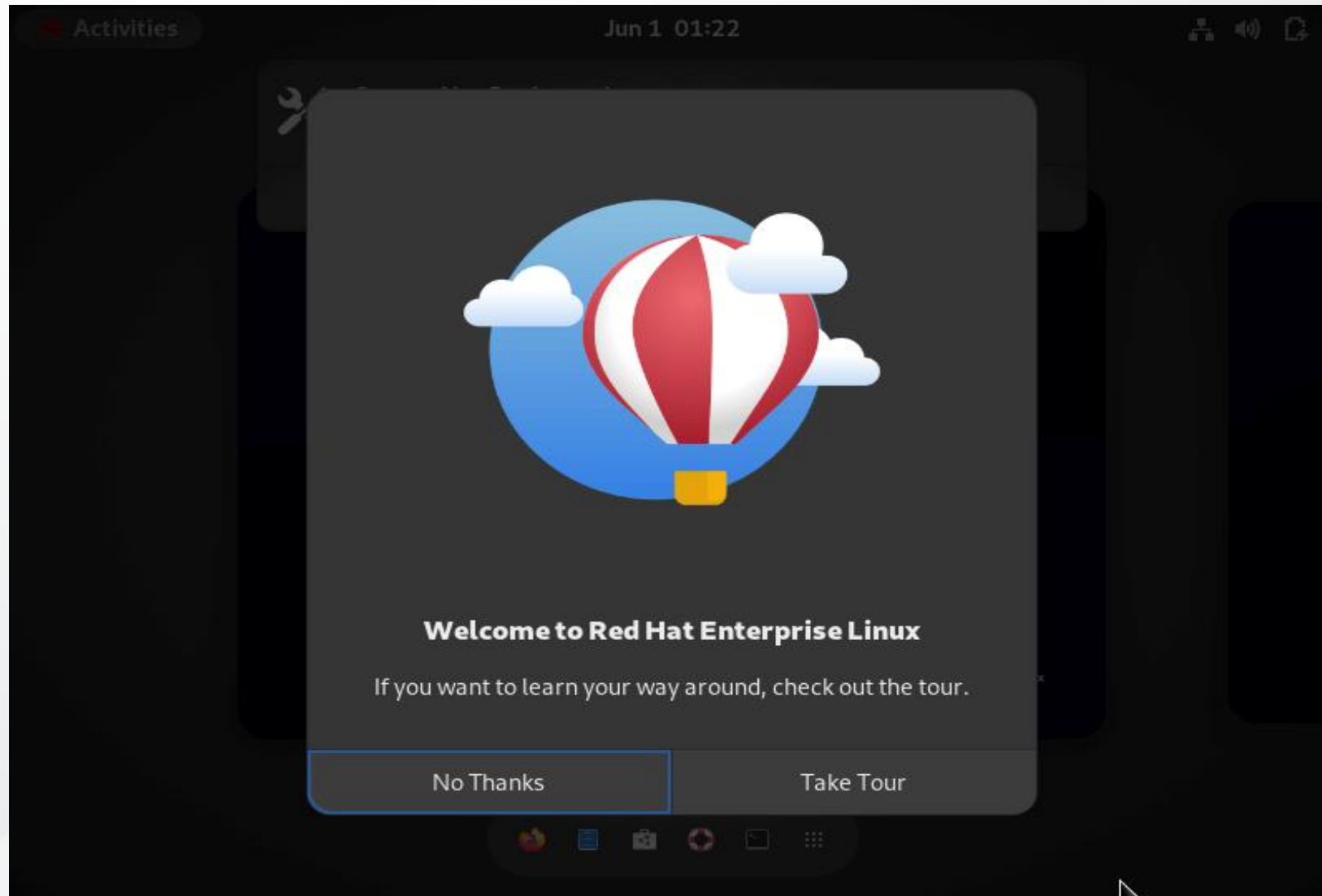
Use of this product is subject to the license agreement found at `/usr/share/redhat-release/EULA`



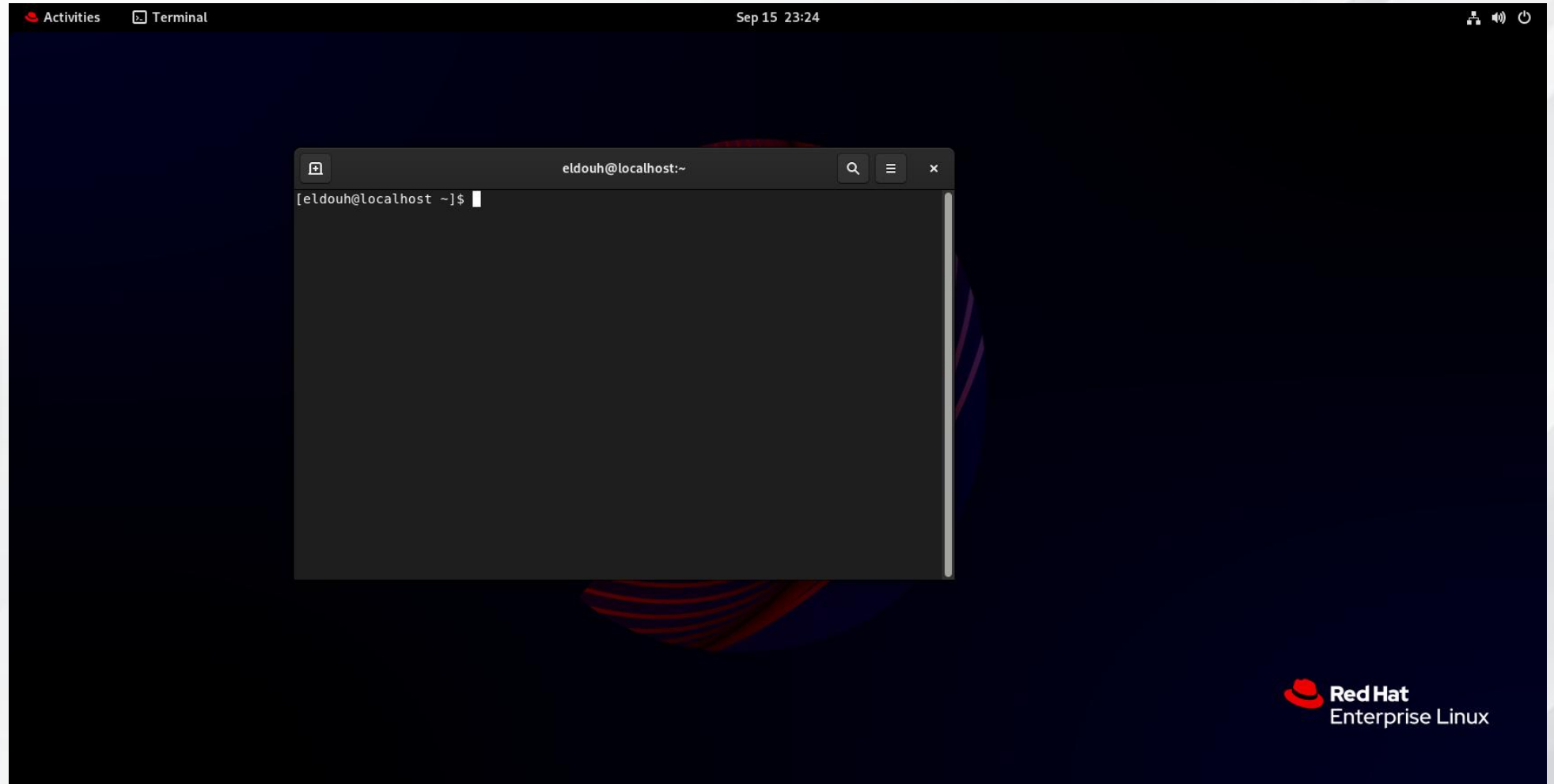
```
Red Hat Enterprise Linux (5.14.0-70.13.1.el9_0.x86_64) 9.0 (Plow)
Red Hat Enterprise Linux (0-rescue-15f5356aa37041bab5822a7a85a4b6a5) 9.0→
```

Use the ↑ and ↓ keys to change the selection.
Press 'e' to edit the selected item, or 'c' for a command prompt.





Click Ready



Basic Commands

ls

List files and directories

cd directory_name

Change directory

pwd

Print working directory

man command_name

Display manual for a command

mkdir directory_name

Create a new directory



Thank You