

Open-Source Software, Linux & RHEL

Introduction, industry significance, distributions, features, and benefits

Learning Objectives

Define open-source software and explain its basic principles.

Discuss the significance of open source in the software industry.

Explain Linux as a kernel and distinguish it from a distribution.

Identify major Linux distributions and their typical uses.

Describe RHEL features, benefits, and enterprise applications.

Introduction to Open-Source Software

- Open-source software is distributed under a license that allows users to use, study, modify, and redistribute the software.
- Its source code is available for inspection and improvement.
- Open source emphasizes permissions and collaboration—not necessarily zero cost.
- Organizations may provide paid support, hosting, training, security updates, or consulting.

Core Principles of Open Source

Principle	Meaning
Access to source code	Users can inspect how the software works.
Use	The software can be used for permitted purposes.
Modification	Users can adapt the code to meet requirements.
Redistribution	Original or modified versions can be shared under license terms.
Collaboration	Communities and organizations contribute improvements.

Examples of Open-Source Software

Software	Area
Linux	Operating systems
Python	Programming and data science
Apache HTTP Server	Web serving
PostgreSQL	Database management
Mozilla Firefox	Web browsing
Kubernetes	Container orchestration
LibreOffice	Productivity software

Industry Significance

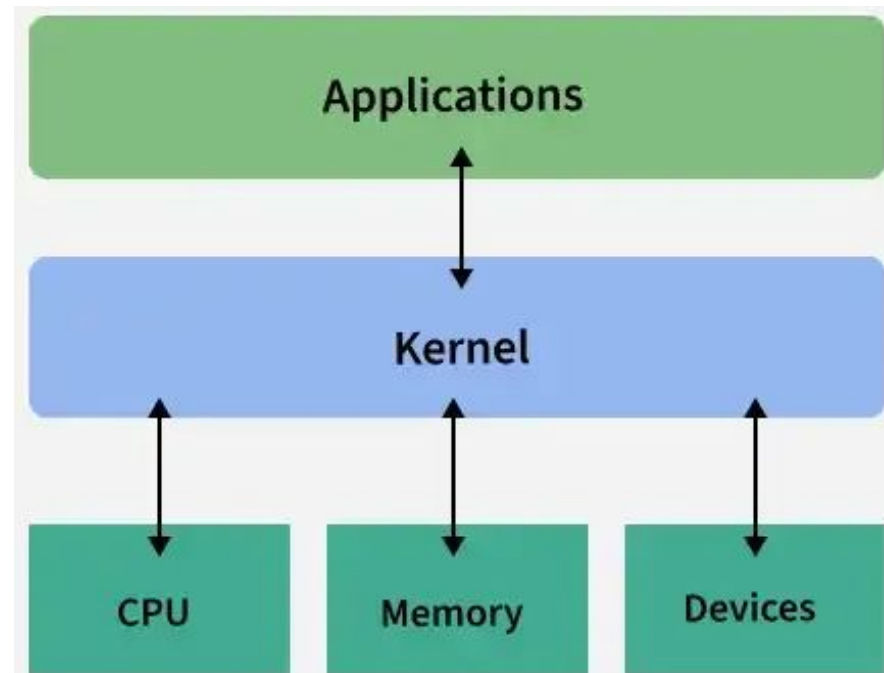
- Open-source software forms a foundation for cloud computing, web services, databases, AI, cybersecurity, mobile systems, and developer tools.
- It enables organizations to reuse proven technologies and build new products faster.
- A 2024 Harvard study cited by the Open Source Initiative estimated the demand-side value of open source at approximately USD 8.8 trillion.
- Open source also supports technology education, experimentation, and workforce development.

Benefits and Considerations

Benefits	Considerations
Lower licensing cost	License compliance
Customization and flexibility	Security maintenance
Faster innovation	Quality and governance
Interoperability	Documentation and support
Reduced vendor lock-in	Community or commercial support

Understanding Linux

- Linux is an open-source operating-system kernel.
- The kernel is the central component that manages hardware and provides services to applications.
- Linux manages processors, memory, files, devices, networking, and permissions.
- In common usage, “Linux” may refer to a complete operating system built around the Linux kernel.



Linux Kernel and User Space

Linux-based systems contain multiple layers:

- **Hardware:** processor, memory, storage, and devices.
- **Kernel:** manages resources and provides core operating-system services.
- **System libraries and utilities:** support programs and administration.
- **Applications:** servers, development tools, browsers, databases, and user software.

Linux Distributions

- A Linux distribution, or distro, combines the Linux kernel with libraries, utilities, package managers, repositories, installers, services, and applications.
- Distributions differ in package selection, release model, administration tools, target users, and support model.
- A distribution turns the kernel into a usable operating-system environment.

Major Linux Distributions

Distribution	Typical focus
Ubuntu	Desktop, education, cloud, and general development
Debian	Community-driven stability and broad software availability
Fedora	Innovation and emerging technologies
RHEL	Enterprise servers, cloud, security, and support
Rocky Linux / AlmaLinux	Community enterprise-compatible systems
Arch Linux	Customization and user control
Kali Linux	Security testing and digital forensics

Introduction to RHEL

- Red Hat Enterprise Linux (RHEL) is an enterprise Linux platform built from open-source components.
- It is designed for stable, secure, scalable, and supported production environments.
- RHEL can run across physical servers, virtual machines, private clouds, public clouds, and edge systems.
- It is used for enterprise applications, databases, containers, automation, and mission-critical workloads.

RHEL Features

Feature	Description
Stability	Tested packages and predictable releases for production systems
Security	SELinux, access controls, updates, and compliance tools
Automation	Tools and roles for repeatable system administration
Management	Web console, insights, configuration, and lifecycle tools
Cloud readiness	Consistent platform across cloud, data center, and edge
Developer support	Languages, runtimes, tools, and enterprise application support

Security in RHEL

- SELinux (Security-Enhanced Linux) provides policy-based mandatory access control.
- Security updates and advisories help administrators address vulnerabilities.
- Hardening and compliance tools help organizations assess system configuration.
- Authentication, authorization, permissions, and auditing support controlled access.
- Security should still be managed through patching, least privilege, monitoring, backups, and incident response.

RHEL Ecosystem

Tool or platform	Purpose
Red Hat Insights	Proactive analysis, recommendations, and system management
Ansible Automation Platform	Automating configuration and administration
Podman	Managing containers
OpenShift	Kubernetes-based hybrid-cloud application platform
Red Hat Satellite	Infrastructure and lifecycle management
Web Console	Browser-based system administration

Benefits of RHEL

- Enterprise-grade stability for production workloads.
- Security capabilities and support for compliance requirements.
- Scalability across servers, virtual machines, clouds, and edge environments.
- Professional documentation, certified solutions, and technical support.
- Planned lifecycle and maintenance help organizations schedule upgrades.
- Automation and centralized management can reduce administrative effort.
- Container and cloud capabilities support modern application development.

Open Source and RHEL

RHEL demonstrates how open-source technology can be packaged as an enterprise platform.

The enterprise value includes:

- Quality assurance and product integration.
- Security maintenance and lifecycle planning.
- Certification across hardware, software, and cloud partners.
- Documentation, management tools, and professional support.

Example: University IT Infrastructure

- Linux can be used in teaching laboratories for operating systems, programming, networking, and cybersecurity.
- Ubuntu or another accessible distribution may be used for student practice and experimentation.
- RHEL may be selected for institutional servers hosting databases, identity services, learning systems, or research applications.
- The choice should consider cost, skills, support, compatibility, security, and lifecycle requirements.

Key Takeaways

- Open-source software provides access, flexibility, collaboration, and reuse under licensing terms.
- Linux is the kernel; a Linux distribution adds the components required for a complete operating system.
- Different distributions target different users and workloads.
- RHEL is an enterprise Linux platform emphasizing stability, security, scalability, support, and lifecycle management.
- Open-source foundations and professional enterprise services can work together.

Discussion Questions

What is the difference between open-source software and free software?

Why is Linux described as a kernel?

What components make up a Linux distribution?

Which factors should an organization consider before selecting RHEL?

How can open-source software support AI and computer science education?