Red Hat System Administration I

What Is Linux?

Why Should You Learn about Linux?

Linux is a vital technology for IT professionals, widely used across the world. It powers web servers, e-commerce platforms, stock markets, smart devices, and even supercomputers. Linux is at the core of cloud computing, containerized applications, and big data solutions.

With its growing presence in enterprise, cloud, and IoT, understanding Linux is essential:

- Windows users often need to interact with Linux systems.
- Application development relies on Linux for hosting and runtime environments.
- Cloud computing heavily depends on Linux for both private and public cloud instances.
- IoT and mobile applications frequently run on Linux.
- IT career opportunities increasingly demand Linux expertise.

Learning Linux enhances technical skills and opens doors to high-demand job roles in IT.

What Makes Linux Great?

Linux stands out for several reasons:

- Open Source – Linux's open-source nature allows anyone to view, modify, and share its code, fostering innovation and continuous improvement.
- Powerful Command-Line Interface (CLI) – Designed for efficiency, Linux enables full system control, automation, and remote management through the CLI, making it ideal for scripting and administration.
- Modular Design – Linux is highly customizable; components can be easily replaced, upgraded, or removed, allowing it to function as anything from a full-featured workstation to a minimal software appliance.

These features make Linux a flexible, powerful, and stable choice for IT professionals.

What Is Open Source Software?

Open source software is software whose source code is openly available for anyone to use, study, modify, and share. Unlike proprietary software, which restricts access to its code, open source licenses allow users to freely run, adapt, and redistribute the software.

Key Benefits of Open Source:

- Control – Users can inspect and improve the code.
- Training – Developers can learn from real-world examples.
- Security – Anyone can review and fix vulnerabilities.
- Stability – Open source projects can continue even if the original developers stop maintaining them.

Open source is widely used in commercial environments, with companies like Red Hat offering support and services for open source solutions. It fosters innovation, collaboration, and transparency, making it a cornerstone of modern software development.

Types of Open Source Licenses

Open source software licenses determine how code can be used, modified, and shared. The two main types are:

- Copyleft Licenses – Require that any modified or distributed code remains open source, ensuring continued community access. Examples: GNU GPL, LGPL.
- Permissive Licenses – Allow unrestricted code reuse, even in proprietary software, as long as original copyright notices remain intact. Examples: MIT, BSD, Apache 2.0.

Copyleft encourages open development, while permissive licensing maximizes flexibility for reuse.

Who Develops Open Source Software?

Today, most open source software is developed by professionals working for organizations that fund contributions to meet business and customer needs. However, volunteers and academics still play a crucial role, especially in emerging technologies. This mix of professional and community-driven development creates a dynamic and innovative ecosystem.

What Is a Linux Distribution?

A Linux distribution is a complete, installable operating system built around the Linux kernel and supported by various open-source programs and libraries. It simplifies the process of setting up and managing a Linux system by bundling essential components like GNU utilities, graphical interfaces, and server applications.

Key points about Linux distributions:

- They include a Linux kernel and user-space programs.
- They range from minimal, single-purpose systems to full-featured OSes.

- They provide tools for installation, updates, and software management.
- Distribution providers offer support and often contribute to development.

Popular distributions cater to different needs, making Linux versatile for various applications.

Who Is Red Hat?

Red Hat is a leading provider of open-source software solutions, specializing in Linux, cloud computing, middleware, storage, and virtualization. It plays a key role in connecting businesses with open-source communities and partners to develop innovative technologies.

Best known for Red Hat Enterprise Linux (RHEL), Red Hat also contributes to projects like JBoss (middleware), OpenShift (containers), OpenStack (cloud), and Ceph/Gluster (storage). With a strong commitment to open source, Red Hat continues to shape the future of IT.

Red Hat Enterprise Linux Ecosystem

Red Hat Enterprise Linux (RHEL) is Red Hat's commercial, production-grade Linux distribution, developed through a structured process:

- Open Source Contributions – Red Hat supports and improves open-source projects by contributing code, resources, and collaboration.
- Fedora Integration – Fedora serves as an innovation hub where new features are tested before moving to CentOS Stream and RHEL.
- CentOS Stream to RHEL – Red Hat stabilizes CentOS Stream, refining it for long-term support and enterprise readiness in RHEL.

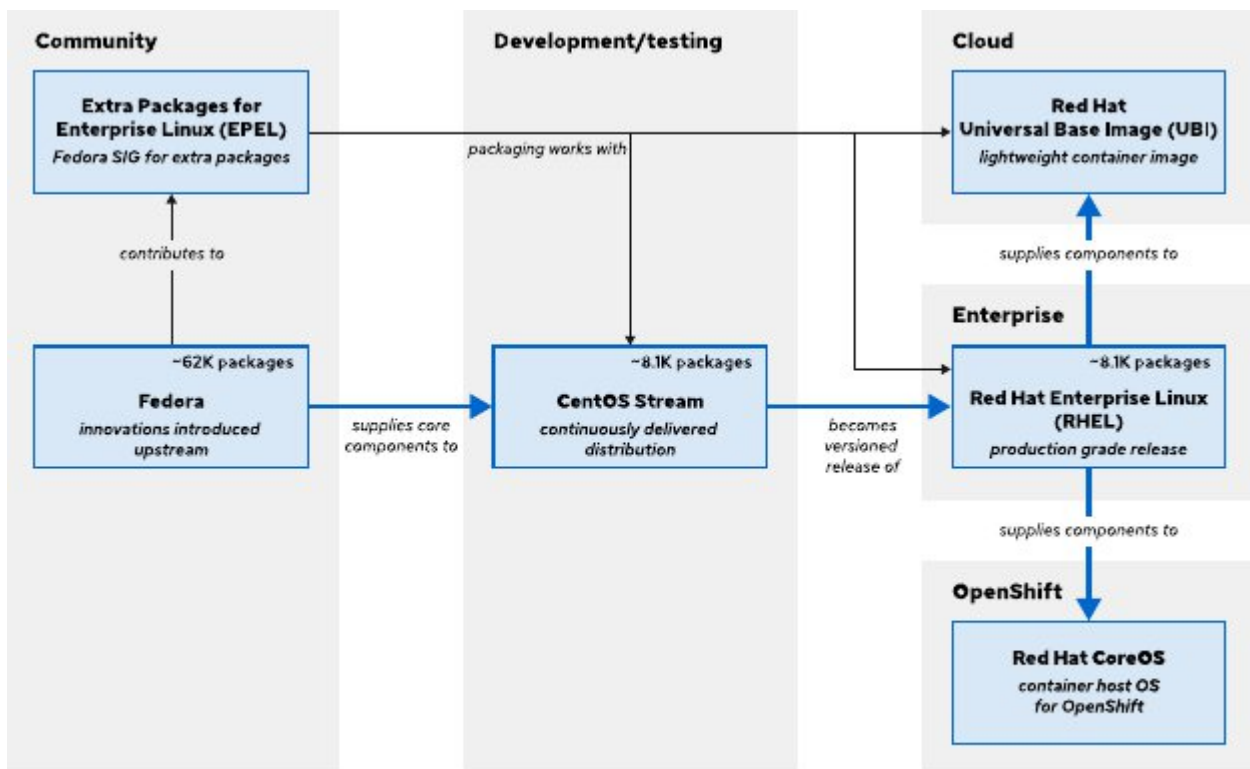This ecosystem ensures RHEL remains a secure, stable, and enterprise-ready Linux platform.

Figure 1.1: The Red Hat Enterprise Linux ecosystem

Fedora

Fedora is a **community-driven, fast-moving Linux distribution** sponsored by Red Hat. It serves as an **innovation hub** where the latest open-source technologies are integrated and tested before reaching enterprise platforms like CentOS Stream and RHEL.

Key features of Fedora:
- **Cutting-edge software** with major updates every six months.
- **Focus on innovation** over long-term stability.
- **Short support cycle** (about one year per release).

Fedora plays a crucial role in shaping the **Enterprise Linux ecosystem**, serving as a testing ground for future stable releases.

Extra Packages for Enterprise Linux

EPEL is a community-supported repository maintained by a Fedora Special Interest Group (SIG). It provides additional packages for RHEL that are not included in Red Hat's official support but meet Fedora's quality standards.

Key points:
- EPEL aligns with major RHEL versions to support extra software dependencies.
- EPEL Next allows building packages against CentOS Stream, helping adapt to upcoming RHEL changes.
- Not officially supported by Red Hat, but widely used for extending RHEL functionality.

EPEL enables RHEL users to access a broader range of software while maintaining enterprise-grade reliability.

CentOS Stream

CentOS Stream is the upstream development platform for RHEL, providing a transparent, continuously updated preview of the next RHEL release. It allows faster integration of patches and community contributions, influencing RHEL development in real time.

Key points:
- Continuous integration & delivery (CI/CD) with tested nightly builds.
- Open contributions enable faster security fixes and feature updates.
- Supports multiple architectures like x86_64, ARM64, IBM Power, and IBM Z.
- Alternative to legacy CentOS Linux, designed to bridge Fedora and RHEL development.

CentOS Stream is suitable for development, testing, and some production use cases, with free RHEL developer subscriptions available for small-scale needs.

Red Hat Enterprise Linux

RHEL is **Red Hat's production-ready, commercially supported Linux distribution**, recognized as the leading platform for open-source computing. It is extensively tested and backed by a global support ecosystem, including **hardware/software certifications, consulting, training, and long-term support.**

Key Features:

- **Built from CentOS Stream**, ensuring transparency and community collaboration.
- **Subscription-based model** (no license fees) providing updates, security patches, and enterprise support.
- **10-year lifecycle**, with extended support available.
- **Certified by software vendors**, ensuring compatibility and stability.
- **Enterprise-grade security**, including dedicated security teams and compliance certifications.
- **Management tools & expert support** through the Red Hat Customer Portal.

RHEL is ideal for **enterprise deployments requiring stability, security, and vendor support**, with free developer subscriptions available for learning and testing.

RHEL for Edge

RHEL for Edge is an **image-based variant of RHEL** designed for efficient deployment and management in edge computing environments. It utilizes **Image Builder**, allowing IT teams to create and maintain **custom, purpose-built OS images** with minimal effort.

Key Features:

- **Optimized for edge architectures** with customizable deployments.
- **Secure management & scaling**, including **zero-touch provisioning** and system health monitoring.
- **Quick security remediations** from a unified interface.

RHEL for Edge simplifies **large-scale, remote deployments** by providing a streamlined, **secure, and scalable** approach to managing edge infrastructure.

Red Hat CoreOS

Red Hat CoreOS (RHCOS) is an **image-based RHEL container host** designed for **Red Hat OpenShift**. It is built from **RHEL components** but is **not a standalone OS**—instead, it is integrated, upgraded, and managed within **OpenShift** for cloud-native applications.

Key Features:

- **Optimized for OpenShift**, providing a secure and minimal container host.
- Uses **CRI-O**, a lightweight container runtime for Kubernetes.
- Designed for **automated updates and immutability** to enhance security and stability.

To fully understand RHCOS, it is recommended to first learn about **OpenShift and containers**.

Red Hat Universal Base Image

Red Hat Universal Base Image (UBI) is a freely redistributable **RHEL-based container image** designed for **cloud-native and web applications**.

Key Features:

- **Subset of RHEL**, sourced from secure RHEL channels.
- **Supported on Red Hat platforms**, such as **OpenShift and RHEL**.
- Provides **base images and application images** (Python, Ruby, Node.js, Nginx, etc.).
- Includes **RPM repositories** for adding package dependencies.

UBI allows developers to focus on application development while ensuring **security, stability, and compatibility** within containerized environments.

Red Hat Enterprise Linux Continuous Development

Red Hat Enterprise Linux Continuous Development follows a structured pipeline from **Fedora** to **RHEL**, ensuring stability and reliability.

Development Process:

- **Fedora Rawhide**: Acts as a **testing ground** for new kernels, drivers, and software before Fedora's official release.
- **CentOS Stream**: Serves as the **continuous integration platform** for the next **RHEL minor release**, incorporating rigorously tested updates.
- **RHEL Builds**: Updates from **CentOS Stream** are pushed into **nightly RHEL builds**, undergoing **hardware, integration, and performance testing** before public release.

This model ensures **transparency**, community participation, and a **structured path from innovation to enterprise stability**.
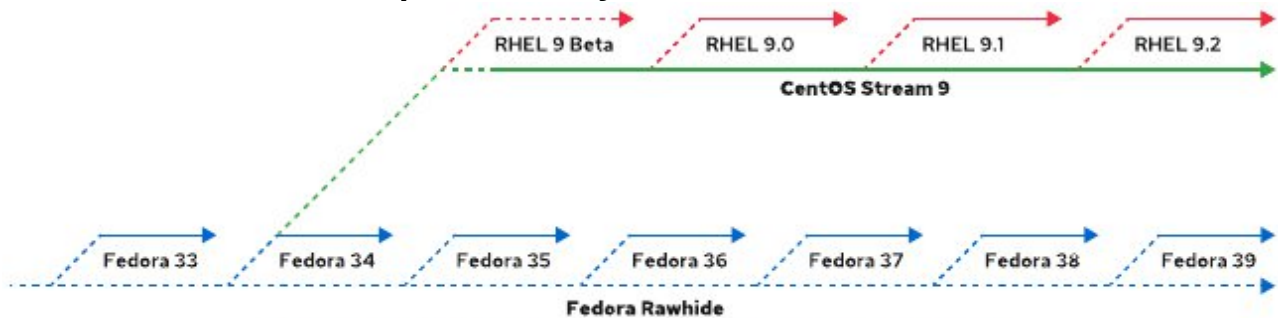

Figure 1.2: Red Hat Enterprise Linux continuous development

Obtaining Red Hat Enterprise Linux

RHEL is primarily available through a **paid support subscription**, but there are multiple **free** ways to access it:

Free & Community Versions

- **Fedora Linux**: Freely available from [Fedora Project](#), including Fedora CoreOS.
- **EPEL & EPEL Next**: Community-supported repositories at [Fedora EPEL Docs](#).
- **CentOS Stream**: Upstream version of RHEL, available at [CentOS Stream](#).

Red Hat Official Access

- **RHEL Evaluation**: Free trial at Red Hat Evaluation with limited support.
- **Red Hat Developer Subscription**: Free for individual developers via [Red Hat Developer Program](#), with updates but no official support.

Cloud & Containers

- **Public Cloud**: Deploy RHEL on **AWS, Google Cloud, and Azure** with official Red Hat images and **Cloud Access** subscription management.
- **Containers**: **Red Hat Universal Base Image (UBI)** is free for development but requires a Red Hat-supported platform (RHEL/OpenShift) for full support.

RHEL offers **flexible access options**, from **community-driven distributions** to **enterprise-ready deployments** in **cloud and container environments**.