**OPERATING SYSTEMS**

**OS:**

An Operating system is system software that acts as an intermediary between computer hardware and the computer user. It provides a set of services and functionalities that facilitate the execution of user applications, manage hardware resources, and ensure a stable and secure computing environment.

**Linux Distributions**

**Linux:**

* A Linux distribution or distro is an installable operating system built from the Linux Kernel, supporting user programs, repositories and libraries. Each vendor or community’s version is a distro.
* Because the Linux Operating system is open sourced and released under the GNU General Public License (GPL), anyone can run, study, modify and redistribute the source code or even sell copies of their modified code. This differs greatly from traditional operating systems – Unix, Microsoft Windows, and MacOS- which are proprietary and far less modifiable.

**Key Features of Linux:**

1)Open-Source

2)Free and customizable

3)Secure and Stable

4)Wide range of distributions

5)Customizable desktop environments

6)Powerful command-line interface

7)Community-driven development

**GNU –** GNU stands for GNU’s Not Unix. It is a free software project and a mass collaboration of programmers and enthusiasts who develop and provide free software for users to have the freedom to run, share, study, modify and redistribute software.

**Popular Linux Distros:**

1)Arch Linux

2)Centos

3)Debian

4)Elementary OS

5)Fedora Linux

6)Gentoo Linux

7)Kali Linux

8)Linux Lite

9)Linux Mint

10)MX Linux

11)SUSE

12)RedHat

13)Ubuntu

14)Zorin OS

**Debian:**

Debian is a free and open-source operating system (OS) that is known for its stability, security and commitment to free software principles. It is developed by the Debian Project, a volunteer organization made up of individuals and organizations from around the world.

The latest version of Debian is Debian 12, codenamed “Bookworm”.

**Key Features:**

**1)Package Management** – Debian uses the Debian Package Management System(dpkg) along with Advanced Package Tool (APT) for package management. This makes it easy to install, upgrade, and remove software packages.

**2)Stability** – Debian is re-owned for its stability. The release cycle is known for being conservative, and updates prioritize stability over having the latest software versions.

**3)Architectures** – Debian Supports a wide range of hardware architectures, making it versatile and suitable for various types of devices

**4)Branches** – Debian supports a wide range of hardware architectures, making it versatile and suitable for various types of devices, from servers to desktops to embedded systems.

**5)Free Software Philosophy** – Debian is commited to the principles of free software, meaning that users are free to use, modify and distribute the software. The Debain Free Software Guidelines outline these principles.

**6)Community-Driven** – Development of Debian is carried out by a large and diverse community of volunteers. The project is organized into various teams responsible for different aspects, such as packaging, release management and quality assurance

**7)Derivatives** – Many Other linux distributions such as Ubuntu are based on Debian. These distributions often inherit Debian’s package management system and other core features.

**8)systemd** – Debian adopted system as its default init system, a significant change that was introduced with Debian 8. systemd is responsible for initializing and managing system services.

**9)Security** – Debian places a strong emphasis on security. The Debian Security Team actively monitors security issues and provides updates and patches to address vulnerabilities.

**Debian based Linux Distributions:**

I)Ubuntu

II)Kali Linux

III)Mint Linux

IV)Parrot OS

**Ubuntu:**

* Ubuntu is a popular and widely used linux distribution based on Debain. It is known for its ease of use, regular release cycle, strong community support and extensive package repositories.
* Ubuntu is available with different desktop environments, including the default GNOME, KDE Plasma, Xfce and others.
* The latest version of Ubuntu operating system for desktop PCs and laptops, Ubuntu 23.10 comes with nine months of security and maintenance updates, until July 2024.
* Ubuntu uses the Debian package management system, APT (Advanced Package Tool), for installing, updating and removing software packages.

**Key Points:**

**GNOME –** GNU Network Object Model Environment is a desktop environment for Linux and other Unix-like operating systems.

Who Is GNOME for?

I)New computer users

II)Productive users

III)Open-Source enthusiasts

**KDE Plasma –** KDE Plasma is a free and open-source desktop environment for Linux and other Unix-like operating systems

Who is KDE Plasma for?

I)Power users

II)Creators

III)Gamers

**Xfce –** Xfce is a free and open-source desktop environment known for its Lightweight nature, Simplicity and usability, Modular design and Stability and reliability

Who is Xfce for?

I)Low-resource users

II)Customizers

III)Linux Enthusiasts

**Kali Linux:**

* Kali Linux is a specialized Linux Distribution designed for penetration testing, ethical hacking and network security assessments. It is developed by Offensive Security. Kali Linux provides a wide array of tools and utilities for cybersecurity professionals, ethical hackers and security researchers.
* Kali Linux uses a custom kernel that includes various patches and configurations to support advanced wireless attacks and other security-related features.
* Kali Linux can be run as a live system from a USB drive or DVD without the need for installation. This allows users to use the OS without making changes to the host system.
* The latest version of Kali Linux is Kali 2023.4 version.

**Linux Mint:**

* Linux Mint typically uses the Cinnamon desktop environment, which provides a traditional desktop layout with a bottom panel, a menu and a system tray. However, Linux Mint is also available in other desktop environments, including MATE and Xfce, catering to different user preferences.
* Linux Mint includes a Software Manager that simplifies the process of installing, updating and removing software. Users can easily browse and install applications from a centralized repository.
* Linux Mint is based on Ubuntu, which is in turn based on Debian. This heritage provides Linux Mint with a stable and well-tested foundation while adding its own features and customizations.
* Linux Mint 21.2 was released in June 2023 is the latest version of Linux Mint.

**Parrot OS:**

* Parrot Security OS is a Debian-based Linux distribution designed for penetration testing, ethical hacking, digital forensics and privacy protection. Similar to Kali linux, Parrot Security OS comes pre-installed with a wide range of security tools for various cybersecurity tasks.
* Parrot Security OS includes a comprehensive set of pre-installed security tools for tasks such as vulnerability assessment, penetration testing, network analysis and digital forensics.
* Parrot Security OS provides AnonSurf, a tool that users anonymize their connection by routing traffic through the Tor network.
* Parrot Security OS can be run in live mode directly from a USB drive or DVD without the need for installation. This allows users to test the operating system before making any changes to their system.
* As of 28 Dec 2023, the latest version of Parrot OS is 5.3.

**Fedora Linux:**

* Fedora Linux is a linux distribution developed by Fedora Project. It was originally developed in 2003 as a continuation of the Red Hat Linux Project. It contains software distributed under versions free and open-source licenses and aims to be on the leading edge of open-source technologies.
* Fedora serves as the upstream distribution for Red Hat Enterprise Linux(RHEL).As a result , many technologies and features that debut in Fedor eventually make their way into the more enterprise-focused RHEL.
* Fedora uses the DNF package manager for package management. The distribution uses RPM packages and supports a wide range of software available through its repositories.
* Fedora allows users to choose from different desktop environments, such as KDE Plasma, Xfce, LXQT.
* COPR – The COPR (Cool Other Package Repository) system allows users to maintain their own repositories with additional or custom packages. It facilitates the sharing of software, including proprietary drivers and multimedia codecs.

**Key Point:**

**LXQT –** LXQT is a free and open-source lightweight desktop environment. LXQT is designed to be fast, efficient and easy to use. It uses the QT toolkit, which is known for its performance and portability. LXQT is available for a wide range of Unix-Like Operating systems, including Linux, FreeBSD and OpenBSD.

**Fedora Based Linux Distributions:**

I)Red Hat Enterprise Linux (RHEL)

II)CentOS

III)Oracle Linux

**Red Hat Enterprise Linux (RHEL):**

* Red Hat Enterprise Linux (RHEL) is a powerful, open-source Linux Distribution developed by Red Hat.
* RHEL follows a long-term support model, providing updates and support for a longer duration compared to regular releases. This stability is particularly important for organizations that require a consistent and predicable environment.
* RHEL incorporates various security features, including SELinux (Security-Enhanced Linux), which provides mandatory access controls. Red Hat actively addresses security vulnerabilities and releases timely security updates.
* RHEL uses the RPM (Red Hat Package Manager) package management system. The ‘yum’ and ‘dnf’ package managers are commonly used for installing, updating and managing software packages.
* The latest version of Red Hat Enterprise Linux 9.1 and 8.7.

**CentOS:**

* CentOS, The Community ENTerprise Operating system, is a free and open-source Linux distribution that aims to provide a binary-compatible alternative to Red Hat Enterprise Linux (RHEL). CentOS is built from the same source code used by RHEL, with Red Hat’s trademarks removed.
* Similar to RHEL, CentOS provides long-term support for each major release. This endures that organizations can rely on a version for an extended period, receiving security updates and bug fixes.
* CentOS uses the RPM package management system. The ‘yum’ package manager and later ‘dnf’ are used for installing, updating and managing software packages.
* The latest version of CentOS is CentOS 8, which was released in September 2019.

**Oracle Linux:**

* Oracle Linux is a Linux distribution packages and freely distributed by Oracle, available partially under the GNU General Public License since late 2006.
* It is compiled from Red Hat branding with Oracle’s. It is also used by Oracle cloud and Oracle Engineered Systems such as Oracle Exadata and others.
* Oracle Linux includes the Unbreakable Enterprise Kernel, which is optimized for performance, scalability and security.
* Oracle Linux supports the Btrfs (B-tree file system) file system, which provides advanced features such as snapshots, cloning and integrated RAID.
* Oracle Linux have the option to purchase Oracle Linux Support from Oracle. This support includes access to patches, updates and technical assistance.

**Other Linux Distribution:**

**I)Gentoo –** Gentoo Linux is a source-based Linux Distribution known for its flexibility, customization and performance optimization. Unlike binary distributions, Gentoo allows users to compile software from source code to tailor it to their specific hardware and requirements.

**II)Arch Linux –** Arch Linux is a lightweight and highly customizable Linux distribution that follows a rolling release model. It is designed to be simple, minimalistic and user-centric, allowing users to build their Linux system from the ground up.

**III)BlackArch Linux –** BlackArch Linux is a penetration testing and security -focused Linux distribution that is based on Arch Linux. It is designed for ethical hackers, security researchers, and penetration testers, providing a wide array of pre-installed tools for testing and assessing the security of computer systems and networks.

**IV)Elementary OS –** Elementary OS is a Linux distribution that aims to provide a user-friendly and visually appealing desktop environment. It is known for its focus on simplicity, elegance and ease of use.

**BareMetal OS Installation:**

Installing an Operating System directly on bare metal means installing it directly in the physical hardware of a computer, without the use of a hypervisor or another underlying operating system.

**Installing a Linux Distribution on Bare Metal:**

**1)Prepare Installation Media –**

* Downloading the ISO image of the Linux Distribution
* Creating a bootable USB drive using tools like Rufus, UNetbootin or dd command (Linux).
* Inserting the USB drive into the target computer.

**2)Boot from installation Media –**

* Power on or restart the computer.
* Access the BIOS or UEFI firmware settings during the boot process. This is usually done by pressing a specific key(eg.,F2,F10,F12) depending on your computer’s manufacturer.
* Set the USB drive as the primary boot device

**3)Initiate Installation –**

* The system will boot from the USB drive, and you’ll see the Linux distribution’s installation screen.
* Follow the on-screen instructions to initiate the installation.

**4)Partitioning –**

* Choose the disk or partition where you want to install the operating system.
* Configure partitioning options, such as creating root(/),swap and possibly a separate home (/home) partition.

**5)User and System Configuration –**

* Setting the system hostname, time zone and keyboard layout.
* Creating user account and setting password.

**6)Install Boot Loader –**

* Choose the location for installing the boot loader (GRUB), This is usually the Master Boot Record (MBR) or the EFI System Partition (ESP).

**7)Complete installation –**

* Confirming the choices and proceed the installation
* Once the installation is complete, the system will prompt you to remove the installation media and press Enter to reboot.

**8)First Boot –**

* Remove the USB drive or change the boot order in the BIOS/UEFI to boot from the installed disk.
* The system should now boot into the newly installed operating system.

**KVM:**

* KVM or Kernel Based Virtual Machine, is a Linux kernel module that enables the virtualization of hardware. It provides a set of kernel modules that allow the host system to act as a hypervisor, creating and managing virtual machines (VMs).
* KVM is part of the Linux kernel and it leverages hardware virtualization extensions to enhance virtualization performance.

**Key Concepts of KVM:**

* **Hypervisor:** KVM serves as the hypervisor, allowing multiple virtual machines to run on a single host system. It creates a virtualization layer between the hardware and the guest operating systems.
* **Guest Operating Systems:** Virtual machines running on a KVM-enabled system are referred to as guest operating systems. These VMs can run a variety of operating systems, including Linux, Windows and others.
* **Hardware Virtualization Extensions:** KVM relies on hardware virtualization extensions provided by modern CPUs. For intel processors, this is known as VTx and for AMD processors, it is known as AMD-V. These extensions enhance virtualization performance by offloading certain tasks to the CPU.
* **QEMU (Quick Emulator):** KVM is often used in conjunction with QEMU, a user-space emulator. QEMU provides additional features such as device emulation and management of VM resources.

**Usage of KVM:**

**I)Install KVM Packages:** On Linux/Debian-based systems can install ‘qemu-kvm’ and ‘libvirt-bin’ packages.

**II)Create Virtual Machines:** Use tools like Virt-Manager or command line utilities to create and configure virtual machines.

Specify details such as the amount of RAM, CPU cores, storage and network configuration.

**III)Install Guest Operating Systems**: Install the desired guest operating system using ISO images or other installation media.

**IV)Manage Virtual Machines:** Use tools like Virt-Manager or command line utilities to start, stop, and manage virtual machines.

Monitor VM performance and resource usage.

**V)Networking:** Configure networking for virtual machines, including options for NAT, bridge networking or assigning dedicated IP addresses.

**VI)Security considerations:** Implement security best practices, such as isolating VMs, restricting access and keeping the host system and hypervisor up-to-date.

**openSUSE:**

* openSUSE is a popular, community-driven Linux distribution known for its stability, versatility and user-friendly features. It is developed in an open and transparent manner, allowing contributors from around the world to participate in its development. openSUSE provides different editions tailored to various use cases, including desktops, servers and enterprise environments.
* If you are a power user, an IT professional, a sysadmin, or a coder, this is the Linux distro for your laptop! It requires minimum post-installation configuration and comes with a lot of specialized tools like OBS (Open Build Service), openQA, and Kiwi.
* OpenSUSE comes pre-packed with a lot of drivers for newer as well as older laptops.

Unlike other distros on this list it comes only in the two following flavors:

* Tumbleweed
* Leap

**The system requirements for OpenSUSE are:**

* Pentium 4 1.6 GHz or AMD equivalent CPU
* 1GB of RAM (2GB recommended)
* 3GB of storage (5GB recommended)

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28/12/2023

Thursday