Linux Architecture and Advantages

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Abstract

Operating system (OS) is the main driving force without which a computer can't work. People who are using the computer either desktop or laptop, are generally aware of which operating system has been installed in their computers, but they do not know how it is working internally. Operating system word is related to not only desktop or laptop computers. Other devices like tablets and mobile phones also have operating system. Many different operating systems are available in market like Microsoft Windows, UNIX, LINUX, IOS, Android and many more. All the operating systems can't work in all types of electronic devices. For example Windows OS is best suited for desktop and laptop computers. It can also work with mobile phones. Android and IOS are mobile OS and can be used with mobile phones and tables. This paper covers the details of LINUX operating system and the reason why it is more beneficial to use it.

Keywords: Operating System, Linux, Open Source, Architecture, Threats, Kernel, Shell, Distributions, Installation

I. INTRODUCTION

Linux is a free operating system developed by Linus Torvalds and first released in October 1991 for personal computers [1]. Typically, Linux is packaged in the form known as a Linux distribution (Distro), for both desktop and server use. It is simple, elegant, consistent, powerful and flexible OS. Originally it was developed for personal computers based on the Intel x86 architecture but then it was adopted by many other hardware platforms as well [14].

It is basically written in C and Assembly language. For Linux, the user interface is either a Command Line Interface (CLI) or Graphical User Interface (GUI).
Linux is a very secure OS which is less affected by network threats like viruses and worms.

Linus Torvalds invented Linux itself. In 1991, Torvalds was a student at the University of Helsinki in Finland where he had been using Minix which is a non-free Unix-like system. Then he began writing his own kernel. He started by developing device drivers and hard-drive access, and then by September had a basic design that he called Version 0.01. This kernel is called Linux, was afterwards combined with the GNU system to produce a complete free operating system.

On January 5, 1992, Linux Version 0.12 was released, an improved, stable kernel. The next release was called Version 0.95. Torvalds released Version 0.11 under a freeware license of his own devising, but then released Version 0.12 under the well established GNU General Public License [21].

Following section gives brief introduction of Linux architecture, Linux kernel and shell, advantages of Linux over other operating system, different Linux distributions and different types of Linux installations.

II. LINUX ARCHITECTURE

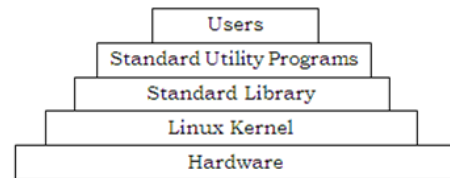The layered structure of the Linux is shown in following figure.

Fig 1   Linux Architecture

- *Hardware:* The bottom layer is the hardware. It consists of various physical devices such as CPU, memory, disks, monitors, printers, etc.
- *Linux Kernel*: The next higher layer is the Linux kernel. It is the core of the OS. It manages all the underlying hardware. It directly interacts with the hardware and provides user required services [16].

- *Standard Library*: This layer contains set of procedures, one procedure per system call.
- *Standard Utility Program*: In addition to OS and system call library, all versions of Linux supply a large number of standard utility programs. Such programs include command processor, compilers, editors, and text processing programs, file manipulation utilities, a variety of commands, GUI and so on.
- *Users*: The top-most layer is of users. User programs come in this layer. They interact with the system either by using library procedures or by using utility programs such as shells [15].

III. LINUX KERNEL AND SHELL

Kernel is the core of the Linux OS. Kernel is a program, which is loaded in memory when system is turned on [5]. It stays there and provides various services until the system is turned off.

Device drivers can be loaded and unloaded into kernel in form of kernel modules. Kernel interacts with the hardware directly [11]. When user program needs to use any hardware, it has to use services provided by the kernel. Special functions, called system calls are used to request kernel [6]. Kernel performs the job on behalf of the user process.Kernel also provides other services like process management, memory management, file system management, etc [4]. Thus kernel manages entire computer system.Code is contributed to the Linux kernel under a number of licenses, but all code must be compatible with version 2 of the GNU General Public License (GPLv2), which is the license covering the kernel distribution as a whole. In practice, that means that all code contributions are covered either by GPLv2 (with, optionally, language allowing distribution under later versions of the GPL) or the three-clause BSD license [13]. Any contributions which are not covered by a compatible license will not be accepted into the kernel [2].

Shell is an interface between the user program and the kernel. Users can directly interact with shell.
When user logs-in to the system, process for shell starts execution. It terminates when user logs-out from the system.It works as a command interpreter [4]. It accepts commands from user and translates them into the form, which the kernel can understand easily [7]. It is also a programming language. It provides various programming functionalities.

System calls are special functions of Linux. They are used to request kernel to provide various services, such as reading from a file stored on hard disk.They can be invoked via library procedures or via commands provided by shell or even directly from c program in Linux.System calls are similar to user-defined functions. Difference is that they execute in the kernel mode, having full access to all the hardware, while user defined functions execute in user mode, having no direct access to the hardware.

IV. WHY LINUX

Followings are some advantages of Linux compared to other operating system because of which user may wish to use it.

A. Open Source

Open source means Linux is available with its source code and it's free. Users can download it from Internet and install it. There is no need to purchase its license from market [3][8]. Users have freedom to make changes in source code according to their requirements. These modified versions can also be redistributed. This is a very big advantage compared to other operating system, for example Microsoft Windows is a paid operating system for which user needs to purchase its license and pay almost 10000 to 15000 rupees.

B. Very Stable (No Single Point of Failure)

Linux uses many individual configuration files in a simple text format. It means that there is no single point of failure for system configuration. If one configuration file gets corrupted, only that function breaks and everything else works fine. In other operating system like Windows, where everything is at one location called its registry. If registry gets corrupted, entire system may fail.

C. Easy Installation of Applications

When we need any software what we need is search the executable file of it from Internet and downloads it. Then install the software by installing its .exe file. This is not the case with Linux. All Linux distributions come with so many software by default. To install a software, you simply fire up the add/remove programs utility, search for the program you need, and install it [10]. There is no need to download its executable file from Internet. The package manager will figure out all the requirement and do the work for you and the same goes for when you want to un-install the program, too. This keeps your computer clean of unnecessary programs. Most of the network threats like virus, worms, trozensetc come with files downloaded from Internet. As with Linux there is no need to download executable files from Internet, Linux is almost safe against network threats.

D. Does Not Slow Down Over Time

Compute system generally slows down over a time because of virus, worms etc. Linux does not easily slow down with Spyware, Viruses, Trojans, etc., which can greatly reduce a computer's performance. Also, because Linux does not have a registry, it is not plagued with registry errors which can slow down a computer over time.

E. Full Access of Code

Anyone can have access to the entire source code of Linux. So you have a freedom to change it according to your requirement [11]. For example, you can change look and feel of your desktop in Linux. This is not the case with other operating system. For example if you want to change desktop feel and look in Windows, you can't do it.

F. Efficiently runs on even Older Systems

If you have any old computer with lower configuration then also you can easily and efficiently run Linux on it. This is not the case with other operating system.

G. Online Peer Support

With Linux, you have the support of a huge community via forums, online search, and plenty of dedicated Web sites. Actually community comes in two forms: users and developers [2]. Linux provides an on-line help facility for all the commands. For this purpose, it provides a command named *man*. By using this command, user can have an instant help on any command [17]. You can join the community and give your contribution. You can take suggestions from others and also give suggestions to others.

H. Flexibility in Usage

Linux can be used for high performance server applications, desktop applications and embedded systems too. Linux distributions are available for all types of systems like for desktop and also for server use.

I. A Multi-user and Multi-tasking System

It allows multiple users to work simultaneously on the same system. Different users can login from different machines into the same machine by using programs like TELNET.It allows multiple programs to run simultaneously. Thus it allows multitasking environment.

J. High Performance, Secured and Reliable

Linux provides high performance with minimum requirement of hardware compared to other OS. Linux does not grant full administrator or *root* access to user accounts by default. Linux is highly secured and not infected by threats [12]. You can use your Linux without anti-virus program. System crashes, hangs, virus attacks are almost absent from the Linux world [9].

K. Flexible Interface

Linux supports both types of interfaces, GUI (graphical user interface) as well as CLI (command line interface). GUI makes task of users easy and so makes OS user friendly. CLI provides more options and control to the user.

L. File System Support

File is a container for storing different kinds of information such as text, image, audio, video, database etc. It used to store large amount of data permanently. Linux supports a wide range of file systems such as ext, ext2, ext3, XFS, JFS, etc. it also supports file systems supported by other OS such as NTFS [18].

M. Programming Facility

The Linux shell supports all the programming features such as variables, control statements, loop etc. These features can be used to develop shell programs, called *shell scripts [19]*.

N. Building block Approach

Linux uses the building-block approach to perform complex tasks. To perform complex tasks, simple commands can be combined using pipes and filters.

V. LINUX DISTRIBUTIONS

Followings are the well known Linux distributions [20].

1. Linux distribution for desktop/personal computer

   - ➢ Fedora
   - ➢ Ubuntu
   - ➢ Linux mint

2. Linux distribution for server

   - ➢ Red hat
   - ➢ Debian
   - ➢ OpenSUSE
   - ➢ Slackware
   - ➢ CentOS

3. Linux distributions for virtual servers

   - ➢ VMware
   - ➢ XenServer

LINUX INSTALLATIONS

There are four different types of Linux installation.

1. *Dual Boot:* Computer systems can have more than one OS. Linux can be installed along with other OS. In such situation, user has to decide which operation system to boot when computer system starts.

2. *Live CD/DVD Booting*: Linux can be run as a completely bootable OS from CD/DVD. For this purpose, many Linux distributions provide such bootable CD/DVD referred as live CD/DVD. When computer system is booted from CD/DVD, required files are loaded into main memory from CD/DVD. OS runs using these files. When computer is rebooted after removing CD/DVD, it will boot from the old OS which is installed in the computer system [22].
3. *Virtual Installation*: Linux can also be run as a virtual machine inside another OS. For this, user has to install some virtual server application such as VMware and then install Linux under that host software. Linux will run above the host OS providing all Linux functionalities [23].
4. *Fresh Installation*: This is the most popular installation. It installs Linux as the only OS of the computer.

CONCLUSION

As Linux is a very powerful and free operating system, government is also promoting its more and more use among computer users in computer world. It provides many advantages over other operating systems available in market which are paid. Today many institutes and cooperate sectors use Linux operating system. There are two main reasons behind it, first is it is cost free and second is it is completely free from network threats which is the most serious and dangerous problem now a days in corporate sectors. Because of its specialty Linux is becoming more and more popular among computer users. Initially when Linux came into market, it was not user friendly like it was command prompt bases. GUI was not available. So, most of the users were not comfortable using it. But now complete GUI is available for all the Linux distributions available in market and so users feel comfort while using it. As a computer engineer I also use and recommended the Linux as a best operating system.

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