# G'NOO – THE POWER BEHIND LINUX (GNU/LINUX)

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**ABSTRACT**

*Linux and UNIX based operating systems are popular in market. There are numerous reasons of its been famous and accepted by variety of people, one of them is its utilities which are not only versatile but free as well. This paper emphasis on the secret behind the free Unix based system utilities and who all are responsible behind all this. The real power and thinking behind this project plan is the key success mantra. Most of us, use linux, praise and use its utilities and commands but does not know the real source and existence. This paper is a attempt to understand, explore the design and power behind Linux.*

***Keywords: GNU, Free Linux, Free OS, Linux Utilities,***

## I INTRODUCTION

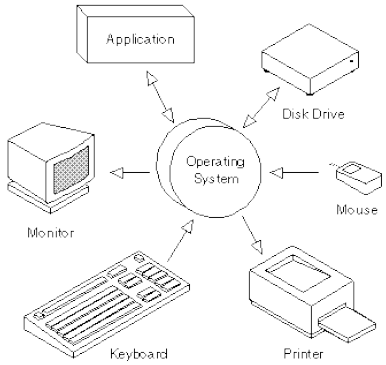
### 1.1 Understand Operating System [1]

Operating system is system software which is a collection of other software components which help in management of computer hardware components and also provide other essential services for the smooth running of the system. Other software programs (application software programs) are dependent on the host operating systems for its smooth working and functioning. So, an operating system program is an interface between the components.

Operating systems perform various tasks like; resource management, user management, process management, memory management, etc. Operating systems are available for all types of systems like windows, Android, Linux, iOS, unix etc.[2][3] OS Operations [4]

Before 1960's the Operating systems did not exist in their modern and more complex forms.[5] Features of Hardware were added, that enabled use of , interrupts, runtime libraries and parallel processing. In the 1980s when personal computers became popular, customized operating systems were made for them similar in concept to those used on larger computers.

Unix which was written by Ken Thompson originally in assembly language.[6] later again rewritten in C.



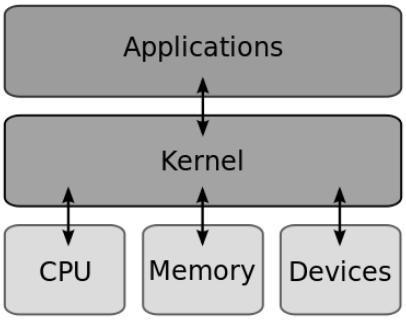

### 1.2 Evolution of UNIX [12]

The UNIX-like family is a combination collection or group of operating systems, with sub-categories like BSD, System V and Linux. The "UNIX" name is a trademark of The Open Group which licenses it for use with any operating system that has conform to standards and their definitions. The term "UNIX-like" is commonly refer to set of operating systems which resemble like original UNIX. This type or say Unix-like systems are well capable of running on to a wide variety of computer architectures. They are used as servers, as well as workstations in variety of environments. Free UNIX variants, such as BSD and Linux, are few among the famous category.

Linux (or GNU/Linux) is a Unix-like operating system that was developed without any actual codeline of Unix, unlike BSD/variants and so. Linux can be used on a wide range of devices, the Linux has open source license, which means anyone can have access and can modify the source-code lines. Although estimates suggest that Linux is used on 1.82% of all personal computers,[7][8] it has been widely adopted for use in servers[9] and embedded systems[10] (such as cell phones). Linux has gained popularity and attained superseded position compared to Unix, and is used on the 10 most powerful supercomputers in the world[11]. Today the Linux kernel is used in various popular distributions, like Ubuntu, Linux Mint, Red Hat,Debian and Google's Android. Android OS is based on Linux kernel and ubuntu desktop Linux distribution

### 1.3 Operating System Components – Overview

A kernel is the in-between layer which connects application to the hardware component [13].As the definition of system says that “System is a combination of logical, physical components/sub systems”. As per definition even an operating system is also a type of system which is comprise of various components and sub-systems. All hardware components are covered by the layered software component, so all user software’s go through Operating System to use any of it’s hardware. The various components of operating systems to discuss few are as follows:




**Kernel**

This is also known as HAL – Hardware abstraction layer, with the help of firmware and device drivers kernel provides control and interaction among all hardware components. It also manage memory access in RAM, along with jobs like managing and scheduling for program access hardware resource.

**Device drivers**

A device driver is a particular type of software developed to allow interaction with hardware devices. This constitutes an interface for communicating with the device. It is a specialized hardware-dependent computer program which is operating system specific that enables another program to interact with a hardware device component. Device drivers goal is provide abstraction.

## 1.4 An Overview of the UNIX Operating System[14]

UNIX begins a server system, was designed to let a number of people or programmers access the computer at the same time and share its resources. The operating system's job is to control all of the commands from all of the keyboards and thus all of the data being generated, and permits each user to believe that they are the only one working on the computer system. UNIX is a resource sharable system. Although UNIX was developed by programmers for programmers, it provides a very strong and flexible environment. Many telecommunications switches and transmission systems also been controlled by UNIX, also administration and maintenance systems are based on unix systems.

**The uniqueness of UNIX**

Some of the key features that made UNIX unique from very beginning are:

- Multitasking capability
- Multiuser capability
- Portability
- UNIX programs
- Library of application software

It also meant that the operating system could be upgraded without having all the customer's data inputted again. And any upgraded versions of UNIX were backward compatible for the proper functioning and working with previous versions, making it easier to upgrade in an orderly manner.

### UNIX tools

UNIX comes with hundreds of pre-programs that can divided into two categories:

- **Integral utilities** that are absolutely necessary for the operation of the computer systems, such as the command interpreter, and
- **Tools** are add-on programs or utilities which are not necessary for the operation of UNIX but provide the user with extra and additional capabilities like e-mail etc.

### UNIX Communications

Today, internet and email is the backbone for everyone starting from normal person to industry person. E-mail is so common today, but it has come into business community just within the last few years. But, that is not the story in the case of UNIX users, who have been enjoying e-mail for several decades. UNIX e-mail service permit users to communicate with each other via their terminals. This is even true for users on different machines of different vendors.

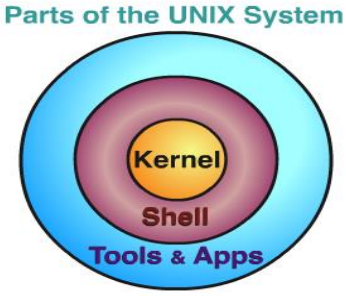
## II APPLICATIONS LIBRARIES

UNIX is not the result of hard work of a day or so. It is developed over years by many people over the years, after coming out from Bell Lab. Slow and steady contribution resulted into hundreds of unix applications (third party vendors) along with build-in applications of unix.

### 2.1 How UNIX is organized

The UNIX system is organized functionally at three main levels:

- The kernel, which schedules tasks and manages storage;
- The shell, which is command interpreter, calls programs from memory, and executes them; and
- The utility tools and applications that offer additional functionality.



## III WHAT IS GNU – OVERVIEW

GNU/Linux – This is a rarely been used name for Linux system, but technically more correct. GNU is an operating system which based upon similar philosophies of Linux. After GNU project started in 1983 by Richard Stallman it slowly grown and achieved everything an operating system needed, except for a complete kernel. Thereafter, of course the Linux kernel was attached and combined along with the various parts of GNU to form the operating system called GNU/Linux, although it is commonly called Linux today.[15]

The vision of GNU project was to create a completely free and open operating system that was similar to Unix but with completely original code lines. Many and many pieces of software for many operating system are licensed under the GNU General Public License.

In 1991, Linus Torvalds (student from finland university) began work on a project, and shared information about his project for computer students and programmers. In response to that he got a huge support and volunteers for creating a complete workable kernel. Programmers from GNU and members worked to integrate the finished GNU parts with the Linux kernel in order to create a full-fledged operating system.

The story of UNIX started with AT&T UNIX System, which came first. But because AT&T UNIX became non-Free, so the result was Richard Stallman started the GNU project to write a Unix system which was Free. The GNU abbreviation is *Gnu is Not Unix*, came into picture. The Plans of GNU were made public in 1983 and development began in the year 1984.

In the early year of 1990s, GNU had started to re-implemented most of the UNIX utilities right from the scratch. The list of components are there in Wikipedia which were not rewritten (TeX, the X Window System, and the Mach microkernel) but most of the, userland tools were again been rewritten in order to meet the goal of avoiding reuse of any AT&T (or rather, non-Free) code, as well as expanding on their capabilities by adding command line options. The result of this is that, the GNU utilities were more powerful than the original tools they been inspired.

At that point of time, GNU was missing only one vital component: that is operating system kernel. In 1991, Linus Torvalds started with toy project which eventually became known as Linux. That was a school project to learn about the then-new 32-bit Intel 80386 CPU, but eventually and incidentally started to make usable operating system's kernel. But it didn't have any user spaced based software; Linux on its own does not provide any type of shell, it is system with no startup mechanism or facilities but only kernel initialization, there is no text editor, not even any graphical interface. The Linux kernel was eventually distributed under the GNU General Public License Free.

Ultimately people started to see it as a pair. User get Unix equivalent user space based programs, along with a kernel based ideas from Unix (including a close resemblance to POSIX), complete with source code that you could alter depending your need, will and on top of the fact that it is FREE.

These days, GNU provides a kernel of its own named and known as GNU Hurd which was not there early, so it was the combination of the Linux kernel and a mostly-GNU userland that got the most attention among developers.

Also, these days, many Unix systems allow the administrator to install easily, parts of the GNU userland. Just for example the GNU Compiler Collection, GNU bash, the GNU C library, and so on.

There is only one UNIX but on the other hand there are so many unix like or say unix based operating systems like Linux or more precisely GNU/Linux systems. At the same time consider Debian GNU/kFreeBSD, which executes a GNU userland on FreeBSD kernel, but not using Linux at all. Another example is Solaris, on which you can easily install various GNU packages including e.g. coreutils.[16]

The GNU/Linux naming is a case of controversy. It is a dispute over how to refer to the computer operating system commonly called Linux.

GNU/Linux is a term promoted by the Free Software Foundation (FSF), its founder Richard Stallman, and its community supporters, for OS that include GNU software and the Linux kernel.[17] The FSF argues for the term GNU/Linux because GNU was a longstanding project to develop a free OS, of which they say the kernel component was the last missing piece.[17]

Pro GNU/Linux members want term dispute GNU/Linux for a number of reasons, like the fact that the term Linux is far more commonly used by the public and media.[18][19]

Plans of GNU, a complete computer OS composed entirely of free software, were made in 1983 by Richard Stallman, founder of the Free Software Foundation.

## IV COMPOSITION OF LINUX-BASED SYSTEMS [20]

Modern free and open source software systems are composed of software by many different developers, including the Linux kernel developers, the GNU project members, and other vendors like X Window System based vendors. Workstation Desktop and server-based distributions use GNU components such as the GNU C Library (glibc), GNU Core Utilities (Coreutils), and bash.

In a 2002 analysis of the source code for Red Hat OS Linux 7.1, the total size of the software or utility packages from the GNU project was found to be much bigger than the Linux kernel.[21]

At the same time on the other hand, some embedded systems, like handheld devices and Android based smartphones (like Google's Android), etc, are engineered with space efficiency in mind and use a Linux kernel with few or no components pieces of GNU. Google's Linux-based operating system - Android does not use any GNU components or libraries, replacing glibc with Google's BSD-based Bionic C library. The FSF agrees that "GNU/Linux" is not an appropriate name for these type of systems.[22][23][24]

There are also cases where systems that use a GNU userspace and/or C library on top of a non-Linux kernel, Example Debian GNU/Hurd (GNU userland on the GNU kernel)[25] or Debian GNU/kFreeBSD (which uses the GNU coreutils and C library with the kernel from FreeBSD).[26]

## V FREE SOFTWARE DEFINITION

As per the definition the Free Software, written by Richard Stallman and published by Free Software Foundation (FSF), is being software that ensures that the end users should have open freedom in using, studying, and modifying that piece of software. That way it is a matter of liberty, and not price. The earliest known publication of the definition was in the February 1986 edition [27] [28] of the now-discontinued GNU's Bulletin publication of FSF. As of April 2008, it is published there in 39 languages.[29] FSF publishes a list of licenses which meet this definition.

In July 1997, Bruce Perens published the Debian Free Software Guidelines.[30] This was also used by Open Source Initiative (OSI) under the name "The Open Source Definition". Despite the philosophical differences between the free software movement and the open source movement, the official definitions of free software by the Free Software Foundation and of open source software by the Open Source Initiative basically refer to the same software licenses, with a few minor exceptions. While stressing on the core differences, the Free Software Foundation comments:

The term "open source" software is used by some people to mean more or less the same category as free software. It is not exactly the same class of software: they accept some licenses that we consider too restrictive, and there are free software licenses they have not accepted. However, the differences in extension of the category are small: nearly all free software is open source, and nearly all open source software is free.[31]

A program is free software if its users have these four essential liberties or freedoms:

- The freedom to run the program, for any purpose (freedom 0).
- The freedom to study how the program works, and change it so it does your computing as you wish (freedom 1). Access to the source code is a precondition for this.
- The freedom to redistribute copies so you can help your neighbor (freedom 2).
- The freedom to distribute copies of your modified versions to others (freedom 3). By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this.

A program is free software if it gives users adequately all of these freedoms. Otherwise, it is nonfree. While we can distinguish various nonfree distribution schemes in terms of how far they fall short of being free, we consider them all equally unethical.[32]

## VI Different packages of GNU[33]

| Name | Description | Homepage | License |
|---|---|---|---|
| AUCTeX | Integrated environment for editing LaTeX and TeX files | http://www.gnu.org/software/auctex/ | GPLv2orlater |
| Acct | GNU system accounting utilities | http://www.gnu.org/software/acct/ | GPLv2 |

| | | | |
|---|---|---|---|
| Aspell | Spell checker | http://aspell.net/ | LGPL |
| AutoGen | Automated program and text generation | http://www.gnu.org/software/autogen/ | GPLv3orlater |
| Bash | Shell of the GNU operating system | http://www.gnu.org/software/bash/bash.html | GPLv3orlater |
| Binutils | Collection of binary utilities | http://www.gnu.org/software/binutils | GPLv2orlater<br>GPLv2<br>LGPLv2<br>GPLv3 |
| Bool | Utility for matching boolean queries in text | http://www.gnu.org/software/bool | GPLv2orlater |
| Combine | Extensible file matching and filtering | http://www.gnu.org/software/combine/ | GPLv3orlater<br>GFDLv1.3orlater |
| Coreutils | Collection of basic file, shell and text manipulation utilities | http://www.gnu.org/software/coreutils/ | GPLv3orlater |
| Diffutils | Finds differences between and among files | http://www.gnu.org/s/diffutils/ | GPLv2 |
| GNU ddrescue | Data recovery tool | http://www.gnu.org/software/ddrescue/ddrescue.html | GPLv3orlater |
| GNUbatch | an advanced batch scheduling system for GNU. | http://www.gnu.org/software/gnubatch/ | GPLv3orlater<br>GFDL |
| Gnu-arch | Revision control system | http://www.gnu.org/software/gnu-arch | GPLv2 |
| Gzip | Compresses and decompresses files | http://www.gnu.org/software/gzip | GPLv2orlater<br>GPLv3orlater |
| Maverik | Virtual reality micro kernel | http://www.gnu.org/software/maverik/ | GPLv2<br>GPLv3orlater |

## VII LINUX – FREE SOFTWARE / DISTRIBUTIONS [34]

A distribution, or distro, is nothing but the Linux operating system. For using Linux, one need to choose a distribution. Distributions are put together by companies or nonprofit groups with the operating system and preinstalled software they feel will best suit and makes combination. Many of these distributions include an application that search the internet for other Open Source software, download and automatically install it free of charge.

Here is the list of some of the more popular distributions below, Ubuntu and Red Hat etc. Ubuntu for example, offer the ability to create a bootable CD so that one can try out Linux without even having to install it over your current operating system.

**Ubuntu**

Ubuntu is a community developed, linux-based operating system that is perfect for laptops, desktops and servers. It contains all the applications you need - a web browser, presentation, document and spreadsheet software, instant messaging and much more.

**Red Hat**

For businesses, governments, or other users looking for stable, supported, and certified Linux. Red Hat can be bought off the shelf at many software retailers and offers various levels of pay support.

**Debian**

Debian is produced by almost a thousand active developers spread around the world who volunteer in their spare time. It comes with over 18,000 packages, precompiled software bundled up in a nice format for easy installation on your machine.

**Gentoo**

A special flavor of Linux that can be automatically optimized and customized for just about any application or need. Extreme performance, configurability and a top-notch user and developer community are all hallmarks of the Gentoo experience.

**SUSE**

SUSE, now part of Novell, is an enterprise level version of the Linux operating system.

**Fedora**

Fedora, sponsored by Red Hat, is a Linux-based operating system that showcases the latest in free and open source software. There is a new release every six months that drives incremental improvements to users at a rapid pace.

**Mandriva**

A full Linux operating system on a single CD for both new and experienced Linux users, it is fast to download and install.

## VIII CONCLUSION

The major impact of linux is cost reduction without compromising versatility and flavor of unix type utilities. Also, this has open alternative gate for data fetching and filtration. No doubt the GNU project not only provide free alternative utilities but also contributed to check and reduce cost for data filter and data extraction, with its innovative free text extortion utilities.

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