ISSN: 2321-8169
62– 68

Comprehensive Review of Open Source Tools and Cross Layer Approach for Fast Growing Android Market

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Abstract:- Talking about the operating system, most of the people around the world are using Macintosh or windowsoperating system then why to bother about LINUX? Which is very less known and used, but these operating systems could not exist without LINUX and its ancestor UNIX. Its superior functionality and the security make it unique from the other operating systems that exist in this world. Actually, internet is the producer of LINUX[1]. The need of high security and better performancewithout rebooting it often made it the best operating system for the use of internet. Linux kernel also make its way to enter in the handheld devices and provides an environment to run various application simultaneously. In the proliferation era of android OS surpassed many changes to assess the maturity level. One in this account is hybrid design of application intended a mix of both native and web based technologies that leveraged to deliver capabilities from both native and web based application. This paper highlights the major rolled played by open source tool and cross-layer approach for growing market opportunity.

LINUX is a UNIX-based operating system which was created by Finnish student named Linus Torvalds in 1991. Linus Torvalds Design the Linux kernel as anopen source as non-enterprise,after then he arguablymake original non-free license to the GPLv2.

It is'open source' software which means it can be easily available to download and use. User can make changes in it according to their use. Due to this reason it has become a very powerful OS that is gaining popularity worldwide, especially among those seeking an alternative to Windows. It is free to use and install, and is more reliable than almost all other systems and it can run for many months and even years without the need of rebooting.

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I. INTRODUCTION

One of the significant benefits of LINUX is that it has no owner therefore it can be debugged without the permission of a license owner. LINUX a multiuser operating system which means on a single computer many users can use the resources and work together. Most of the supercomputers having LINUX in their core system.

LINUXhold immense grip on many different kinds of electronic devices to operate, also nourish much faster than any other operating in era today. This environment include global connectivity frameworklikemany application browser, e-mail client, allowing users to work on the Internet without having to boot all the way into their device's primary operating system even if that operating system is Windows.

Also LINUX is showing up on mobile Internet devices. In this category embedded devices such as Smartphone's and notebook devices are having LINUX in their core. That features

the core functionality of their larger counterparts in a smaller, more energy-efficient package.Cloud computing now a day is more reliable on Linux than any other operating system. Like cloud services of Amazon's A3 works superior with LINUX. Thus we cannot neglect the advantages of Linux over the other existing OS's and also its great impact on the computer world through.

Statistics of different operating system used all over the world

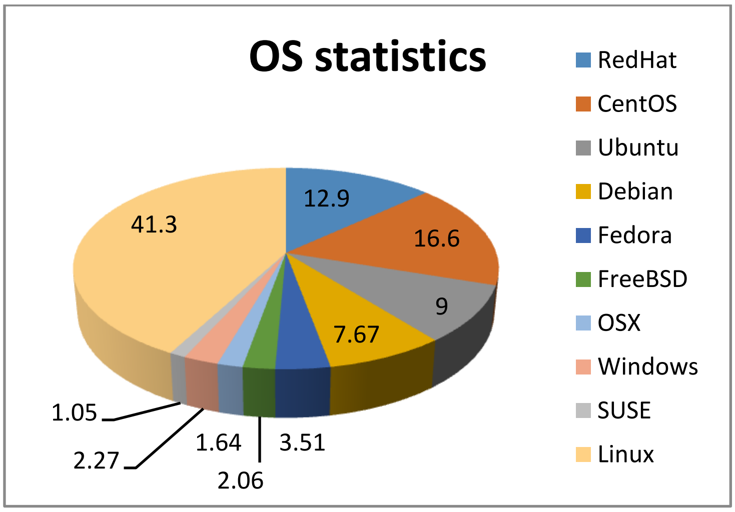

Figure 1

II. FILE SYSTEM

In computing, a **file system**[2] is used to control how data is stored, retrieved or access. A file system organizes data in an efficient manner and is tuned to the specific characteristics of the device. In Linux, everything is configuring as a file. This includes not only text files, folders, images and executables programs, but also directories, device drivers and partitions.

Each file system contains a control block which holds the information about that filesystem. Another block in the file system is inodes, which contains the information about files, and blocks.

There is a difference between the users see the Linux filesystem and the kernel (core of system) actually stores the files. The file system appears as a hierarchical format or arrangement of directories that contains other directories (subdirectories) and files. These files, directories and subdirectories are identified by their names. This structure starts from a single directory called *root*[2], which is represented by forward slash “/”.

The meaning of “/” and root are often confusing to new users. This because each has two different usages. Another meaning of root is a user who has super or administrative privileges on the computer. The other use of “/” is as a separator between directory and file and appear under root directory[3].

The File Hierarchy Standard includes the main directories and their contents in operating systems. All files and directories appear under the root directory. Some directories defined by File Hierarchy System are /boot (boot loader files and such as kernel files), /bin(command binaries), /sbin(executables used by root users), /home (users home directories), /mnt(for mounting of physical devices), /etc (contains all system related configuration files), and /usr (used to store user profile configuration).Linux filesystem implements a basic set of common concepts developed for UNIX. Several Linux filesystem are currently using ext2, ext3, ext4, XFS[3].

Linux first filesystem was minix, which was taken from MINIX OS. The minix filesystem is adopted because it was efficient and bug-free software that postponed designing a new filesystem in Linux evolutionary.The Extended filesystem (ext) was introduced in April, 1992. With has a capacity of maximum partitions size of 2GB and maximum file name size of 255 characters. Ext2 was released in January, 1993. It was rewrite of ext features which was Improved its speed and support maximum file size of 4TB. Ext2 maintains a special field in the superblock that indicates the status of filesystem as either clean or dirty. Ext3 was released in 2001 Ext3 has been integrated into the Linux kernel version 2.4.1 and has default filesystem of Red Hat operating system and other distributions. The main benefit of ext3 is that it allows journaling. When the system crashes, the possibility of file system corruption is less because of journaling. Filesystem size can be from 4TB to 32TB and it can easily convert ext2 file system to ext3 directly without backup or restore.

Extended filesystem (Ext4) was introduced in 2008 and it support Linux Kernel version 2.6.19. Overall maximum ext4 file system size is 1024TB and it contains a maximum of 64,000 subdirectories. Several other new features are introduced like multiblock allocation, delayed allocations, fast fsck, journal checksum etc.

III. PARTITIONS

Partitions means Disk partitioning or division of certain kind of secondary storages such as hard drives via the creation of multiple partitions. Partition of hard disk is depended on different partitions systems such as MBR (Master Boot Record), GPT (GUID Partitions Table).

MBR called Master Boot Record because it is a special boot sector located at the beginning of a drive. This has the information about the drive’s logical partitions and also contains a boot loader for the installed operating system. MBR works with disk size up to 2TB. It cannot handle disk size more than 2TB of space. MBR only supports up to four primary partitions. To create one more partition from partition table one partition should be extended partition and create logical partitions inside it.

GPT is the latest standard for laying out the partitions of the hard disk. The GPT drive has a single partition that extends across the entire drive. GPT have a limit of making 128 logical partitions. It can hold 2^64 blocks in length which is equivalent to 1 billion terabytes.

Linux system used **fdisk**[3] command to set the partition. Storage devices are represented by a special file type block device. The block device stored in a /dev directory. In Linux hard drive is detected is **/dev/sda**, the second is **/dev/sdb** and so on. The first primary partition on **/dev/sda** is **/dev/sda1**, the second partition is **/dev/sda2**, and so on.

(3.1)Creating partition and mounting File system

- Show a report on the present hard drive
  [root@desktop ~]#fdisk –l

```
Disk /dev/sda:21.5GB, 41943040 sectors
Units = sector of 1*512 = 512 bytes
Sector size (logical/physical): 512 bytes
I/O size (minimum /optimal): 512 bytes
Disk label type: dos
Disk identifier: 0x000e4520

Device     Boot   Start    End        Blocks  id  System
/dev/sda1    *     2048    2026047   51200   83 Linux
```

- Create partition in /dev/sda
  [root@desktop ~]#fdisk /dev/sda
  Command (m for help) : n

```
Partition type :
p     primary(2 primary , 0 extended,  2free)
e      extended
```

  Select (default p): p
  Partition number (3, 4 default 3): 3
  First sector (2048-2026047):2048
  Last sector, +sector or +size {K,M,G} (2026047) : +10G
  Command (m for help): w

- Re-reading the partition table
  [root@desktop ~]#partprobe

- Provide file system to partition
  [root@desktop ~]#mkfs.ext4 /dev/sda2

- Print block device attributes
  [root@desktop ~]#blkid

```
/dev/sda1: UUID=”0ceef-nccf-df3”TYPE=”ext4”
/dev/sda2: UUID=”gh2e-hg-4dgv”TYPE=”ext4”
```

- Make directory and mount the partition

```
[root@desktop ~]#mkdir /data
[root@desktop ~]#mount /dev/sda2 /data
[root@desktop ~]#mount –a
```

- Report file system disk space usage

```
[root@desktop ~]#df -h
```

```
Filesystem   Size   Used    Avail  use%  Mount
/dev/sda1     10G    6G      4G    60%   /
devtmpfs     759M   0       759M   0%    /dev
/dev/sda2    10G     0       10G    0%    /data
```

SELinux (Security-enhanced Linux) is an implementation of a mandatory access control mechanism in the kernel, for supporting access control security policies, including US (United States) of Defense[4]. SELinux was created by the National Security Agency (NSA), adds Mandatory Access Control (MAC) to the Linux Kernel, and it is enabled by default in operating system Red Hat Enterprise Linux (RHEL).

When properly executed, it enables an operating system to adequately defend itself and support application security by protecting against the tampering with. MAC provides division of applications that permits the secure execution and untrustworthy applications. SELinux policy rule is administratively-defined, enforced system-wide, confidentiality and integrity, as well as protecting processes from untrusted inputs.

SELinux can either in enabled or disabled state. DAC rules are used when it is disabled state. When Enabled, SELinux can run on two modes enforcing and permissive mode.

Enforcing: SELinux denies access based on SELinux policy rules.

Permissive: SELinux does not deny access, but denials are logged for actions that would have been denied if running in enforcing mode.

To change between enforcing and permissive mode setenforce command is use. Changes made with setenforce command do not persist across reboots. Run setenforce 1 command to change enforcing mode, as the Linux root user. To change permissive mode, rum setenforce 0 command. View the current SELinux mode use getenforce command[3].

```
[root@desktop ~]#setenforce 0
[root@desktop ~]#getenforce
Permissive

[root@desktop ~]#setenforce 1
[root@desktop ~]#getenforce
Enforcing
```

IV. Linux Kernel

Linux kernel version[1] 0.0.1 released on September 1991, and licensed the kernel under the GPL license. The GNU General Public License allows users to use, modify and distribute the source code file legally free of cost. A kernel is the core of an operating system. The operating system allows users to run application program on a computer that manages the hardware. Kernel controls the application and hardware. Application program do not communicate with hardware directly, instead they go to kernel part. Without kernel, a computer is a useless object. Software runs on the kernel and the kernel operates the hardware. Developers coded the source code of the kernel in C programming language. The coding of the kernel will be in files with extension ".c" or ".h". The ".c" extension indicates that the kernel is written in C Programming languages. The ".h" extension files are Header files written in C language.

Linux Kernel is monolithic kernel[5]. That means the whole operating system is on the Random access memory reserved as kernel space. Kernel owns the space on the ram until the system is shutdown. There is a User space on the RAM that the user's program owns. When the application is closed the newly program may use the free space. With kernel space, once the kernel taken the RAM space, nothing else has not permitted that space.

The Linux kernel is also a preemptive multitasking kernel. Means the Kernel will hold some task to ensure that every program gets a chance to use the CPU. If an application is running but is waiting for some data, the kernel will put that application on hold and allows another application to use the freely CPU resources until the data arrives.

The Linux kernel is portable. It supports some of the processor types that include Alpha, AMD, ARM, C6X, INTEL, x86, Microblaze, SPARC, etc.

Source code is the coding of the kernel program. Developers can make changes to the kernel with source code.

The root of the kernel source code contains the directories listed below which is sorted way. This enables developers to find any give file or part of the kernel.

- arch
- block
- crypto
- documentation
- drivers
- firmware
- fs
- include
- init
- ipc
- kernel
- lib
- mm
- net
- samples
- script

- security
- sound
- tools
- usr
- virt

Files are located in the root of the source code.

- .get_maintainer.ignore
- .mailmap
- COPYING
- CEDITS
- kbulid
- kconfig
- MAINTAINERS
- Makefile
- README
- REPORTING - BUGS

COPYING – This file contain the information about licensing and rights. The kernel is licensed under the GPL license. This license grants users the right to use, modify and complied code for free.

CREDITS – List of contributors.

kbuild - kbuild is a script that sets up setting for making the kernel. It sets up an ARCH variable where ARCH is the processor type that a developer wants the kernel to support.

kconfig – kconfig script is used when developer configure the kernel.

MAINTAINERS – it contains the list of maintainers, their email address, website, and the specific part of kernel that they specialize in fixing and developing. When a bug finds in the kernel developer should be report the bug to the maintainer that can handle the issue.

Makefile - Makefile script is the main file that is used to compile the kernel. This script passes parameters or list of files to compile to the compilers.

README - This text file provides information to developers that want to know how to compile the kernel.

REPORTING-BUGS - This document provides information on reporting bugs.

arch - This directory contains a kconfig file which sets up setting for compiling the source code belongs in this directory.
Each file supported processor architecture is in the corresponding directory. Like the source code of INTEL processor belongs in the INTEL directory.

block - This directory holds the code for block-device drivers. It is a device that accept and send data in blocks. It also contain a sub-directory titled 'partitions' files that support hard disk partitioned under Acorn, aix, amiga, atari, check, cmdline, efi, ibm, karma, Idm, mac, msdos, osf, sgi, sun, sysv68, Ultrix architecture.

crypto –This directory contains the code of encryption algorithms. With asymmetric keys directory contains the key code files.

Documentation - This directory contains text documents that provide information on the kernel and many of the files

drivers – This directory contain the code for the drivers that controls a hardware. For a computer to understand the hardware and it make usable, a hardware driver is needed. Many directory exist in this directory, each directory is named after each piece or type of hardware.

firmware – This directory contains code that allows the computer to read and understand the signal from hardware devices. firmware helps the operating system to send messages to the device. Without firmware the operating system does not know how to process the information that the hardware is sending.

fs – fs means Filesystem. This is the directory contains all the code to understand and use filesystem. fs directory contains sub-directory, each filesystem's code is in its own directory.

include - Include directory contains header files that the kernel uses.[] Header file is a file with extension ".h" which contains C function declarations and macro definition and to be shared between several source. Header file used with the C preprocessing directive "#include" in program.

init - The init directory has code that contract with the startup of the kernel (INITIATION). The main.c file is the core of the kernel which connects all of the other files.

ipc – ipc means Inter-Process Communication. It handles the communication layer between the processes and kernel. Kernel controls the hardware and the application can query the kernel to perform a task.

kernel - File in this directory controls the kernel itself. In a kernel directory is a folder named "power". Code in this directory provide the abilities for the computer to power-off, restart, hibernate, autosleep, etc there are many code which perform some different task.

lib – lib directory has the code for the kernel library has set of all files that kernel will needed when setting.

mm – Managing of the memory can be done in this directory . mm means Memory management. Memory cannot randomly allocate on the RAM. Instead, kernel places the data on the RAM and does not overwrite any memory that is being used or holds data.

net –This directory has the code for network protocol includes code for IPV4, IPV6, Ethernet, 802.11n (wifi), Bluetooth, dns_resolver, packet, etc.

samples - This directory has programming examples and modules code of the kernel developers.

scripts - This directory contains scripts code needed for compiling the kernel.

security - It provides the security of the kernel form computer Viruses, Trojans, Worms and hackers.

sound - This directory contains driver code for audio cards.

tools - tools that uses with the kernel.

usr - code in this folder creates files after kernel is compiled.

virt – This directory contains code for virtualization which allows users to run multiple operating system at once by using various tools like VMware, Virtualbox, etc.

Check Linux kernel version on CLI terminal

- uname –a (Print all Information)
  [root@desktop]#uname –a

- uname –r (Print the kernel release name)
  [root@desktop]#uname –r

Manual page, uname has following information

-a, --all	print all information
-s, --kernel-name	print the kernel name
-n, --nodename	print the network node hostname
-r, --kernel-release	print the kernel release
-v, --kernel-version	print the kernel version
-m, --machine	print the machine hardware name
-p, --processor	print the processor type
-i, --hardware-platform	print the hardware platform
-o, --operating-system	print the operating system
--help	display this help and exit
--version	output version information and exit

CROSS PLATFORM

In computing, cross platform is the ability of a programming language (such as java) that enables programmers to develop software and applications for different platforms (operating system) by writing a program only once. Cross platform software can run on most or every system with minimal or no modification. Due to difference in file system and directoryit is difficult to execute android application on windows or windows application on Macintosh and so. But cross platform provides the liberty to the user to run any application on any operating system device, in addition to this it is also cheaper to develop such application. Many other aspects of cross platform app is as simple as maintaining a browser page, which can be conducted as needed[8]. Mobile app classified into three different types:

- Native App
- Mobile Web application
- Hybrid application

Devices for high performance are more cost, which required more complex and seamless application, drag market to prove hardware which is difficult to found in many desktop or laptops in years 1990-2000 now these are easily embedded and available to the use due to drastic revolution in the electronic technology, still many developers focus towards stable and minimal space application that can run on device easily. Cross layer is an advance area of such approach where developers devise to run application on any device independent of operating system[7]. It can either be related to hardware or to software. Hardware platform can refer to a computer architecture or processor architecture. For example: x86 architecture and its variants Such as IA-32 and x86-64.these machines often run one version of Microsoft windows, though they can run other operating system as well including Linux, OpenBSD, NetBSD, Macintosh OSX and FreeBSD. Software platform can either be operating system or programming environment, though more commonly it is a combination of both. Take the example of java, which uses an operating system independent virtual machine for its compiled code, known as the byte code.

This concept can be used for the Linux kernel modification for making a virtual machine that can convert the code of the application to run it on any operating system. By implementing this concept device will be able to run any operating system in it, few example of the cross layer platform framework to create mobile application are enumerated below:

- IONIC
- Mobile Angular UI
- INTEX XDK
- Appcelerator Titanium
- Sencha Touch
- Kendo UI
- PhoneGap

LINUX ON ANDROID

Android is a multi-process system, in which each application (and parts of the system) runs in its own process and it is

First open source mobile operating system. Android's mobile operating system is based on the Linux kernel and is the world's best-selling Smartphone[8]. It was founded in Palo Alto, California in October, 2003 by Andy Rubin, Rich Miner, Nick Sears, and Chris White. Their goal was to develop a "smarter mobile device that was more aware of its owner's location and preferences.

The Android operating system, including the Linux kernel, contains approximately 12 million lines of code[8]. In this there are: 3 million lines of XML, 2.8 million lines of C, 2.1 million lines of Java, and 1.75 million lines of C++. The apps for Android are primarily written in Java. However, there is no Java Virtual Machine in the platform and Java byte code is not executed. Java classes are compiled into Dalvik executable and run on the Dalvik virtual machine. Dalvik is a specialized virtual machine designed specifically for Android and optimized for battery-powered mobile devices with limited memory and CPU.

Figure 2 Android for much new hardware's Conclusion

Android is the fastest growing mobile operating system. It's growing even faster than 'IOS'. More developers are choosing to create Android applications. OHA (Open Handset Alliance), It's a consortium of several companies. These groups of companies are allowed to use source code of Android and develop applications. User gets millions of applications that user cannot get in any other mobile operating system.Other than Android there are several other mobile operating system which is used like Symbian, IOS, windows this are one of the most used mobile operating systems.But android is leading these all very rapidly and proving itself as a giant operating system for smart mobile devices. Organization now a days trying to nourish the growth of their product in the market with widespread and embedded product using vivid enterprise mobiles application. Many native applications are furnish to attack the user to purchase their product, one can estimate a footwear maker companies are designing a Bluetooth enable sensor footwear which can be further connected to smart watch to Measure the day workout. Nab consistent feedback of its customer to maintaining CRM (customer relationship management). This is the kind of database help in storing the customer information.A strategy for applying the analysis to better meet the client needs, also a way to analysis the information in database[9].

In figure 3 we have portrayed the comparison of mobile application in enterprise devices. Demography depict that the native application are much more web based application are lucrative and pragmatic in performance as compare to other approach. The only pitfall in web based application is that user need to have internet access all time for the full functioning in the mobile devices. Although web based application are low cost but unable to nab the focus of many brand, Biggest brand such as Amazon, flip kart, Mantra, Facebook, Instagram, are all keen towards hybrid (native + web based technology app) for their product, since the development cost of such application is comparatively very less than Native application. Online customer have special set of expectation from organization, need to deliver services and product without much delay. By compiling this information and analysis company build value for their customer. Anticipating existing customer needs and maximized business opportunity.

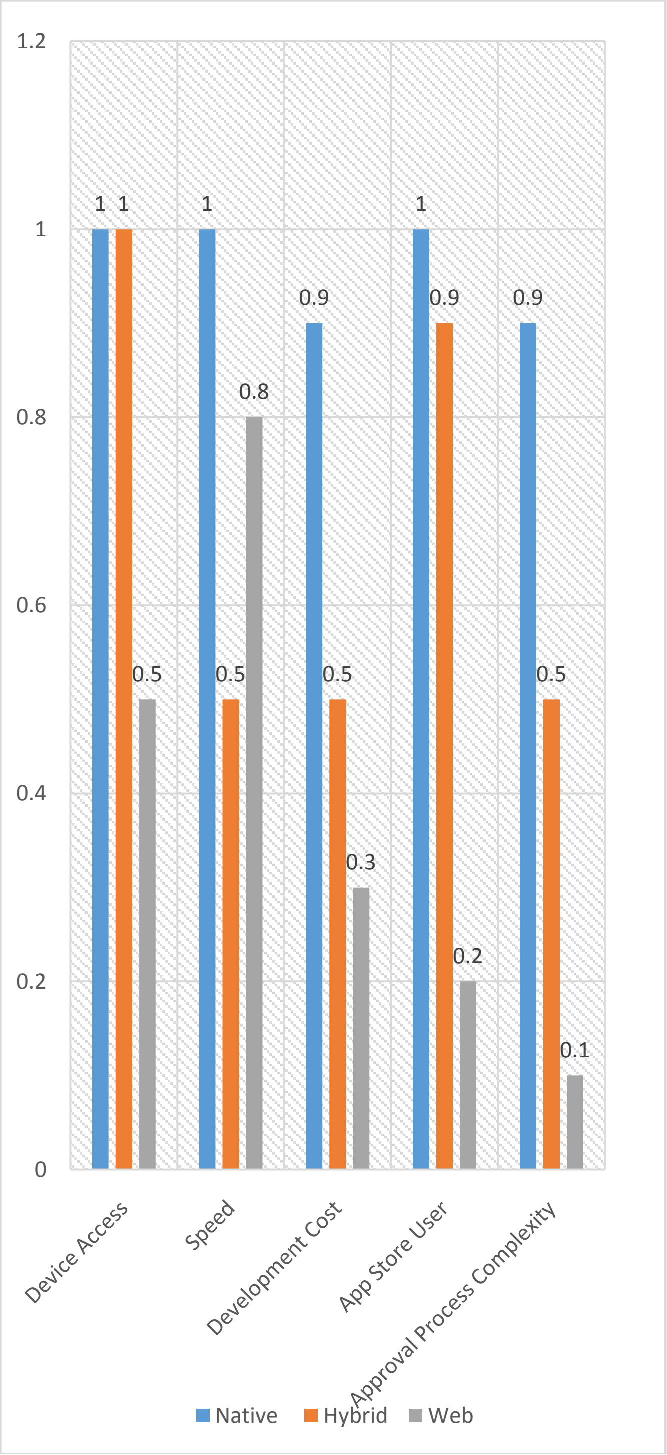

Figure3 Comparison of Mobile application in Enterprise Mobiles

Conclusion

Based on the market imperatives, company may decide whether to use native, hybrid or web approach to suit their needs. This paper highlights the criteria for selecting the mobile app implementation approach based on speed, development cost, process complexity, app store user and devices access.

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