Studying Main Differences between Android & Linux Operating Systems

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***Abstract*— Any IT professional knows that Android, smart phone operating system, was derived from Linux , there are arguments for each side, naturally. The biggest for Android being Linux is, of course, the fact that the kernel for the Linux operating system and the Android operating system are very nearly one and the same. Not completely the same, but Android's kernel is directly derived from Linux. Where things get ambiguous, though, is above the kernel layer. Take one look at the application and interfaces layers and you will see clear differences between the two operating systems, so, this study will try to remove the ambiguous about the main differences between the pre-specified systems.**

***Index Term*— Android, Kernel, Linux, Operating Systems.**

I. INTRODUCTION

Linux (often pronounced LIH-nuhks with a short "i") is a Unix-like operating system that was designed to provide personal computer users a free or very low-cost operating system comparable to traditional and usually more expensive Unix systems. Linux has a reputation as a very efficient and fast-performing system. Linux's kernel (the central part of the operating system) was developed by Linus Torvalds at the University of Helsinki in Finland. To complete the operating system, Torvalds and other team members made use of system components developed by members of the Free Software Foundation for the GNU Project.[1]

Android is a software stack for mobile devices that includes an operating system, middleware and key applications. Google Inc. purchased the initial developer of the software, Android Inc., in 2005Android's mobile operating system is based on the Linux kernel. Google and other members of the Open Handset Alliance collaborated on Android's development and release. The Android Open Source Project (AOSP) is tasked with the maintenance and further development of Android. Android was listed as the best-selling Smartphone platform world-wide in Q4 2010 by Canalys. [2]

1- IS ANDROID A LINUX DISTRIBUTION?

Although the platform built on top of the Linux kernel, according to Google Engineer Patrick Brady, it is not a Linux distribution. It does not support the X-windowing system nor does it use the standard Linux libraries including the Gnu C Library. In fact, the C language is not even officially supported.

Even though Google denies that they are creating a Linux distribution, many people in the tech world refuse to believe it (see articles here and here). Instead they believe that Google is stealthily setting the stage to bring Linux into the mainstream and take on Microsoft.[3]

II. WHAT WILL ANDROID DO FOR LINUX?

Whether or not Android is a Linux distribution, it will still bring attention to the Linux operating system. Very few people in the mainstream understand that there is a difference between the Linux kernel and a Linux distribution. Android will be a Linux "flavor" whether it wants to be or not.

When Android was only able to run on mobile phones, this was not too big of a deal. People are used to having different apps for the iPhone than there are for the Blackberry. Not being able to use an app designed for a LiMo based phone on an Android based phone is not an issue.

However, now that Android is being ported to Netbooks, the fact that it does not natively support applications designed for Linux may be a bit confusing at first. Fortunately, the operating system is completely open source. There are already suggestions for the creation of an Android application that allows for the use of a sandboxed Linux environment in order to run native Linux applications.[4]

III. ANDROID KERNEL AND LINUX KERNEL

The researcher has prepared an annotated list of changed files at the end of this document, and a brief summary here:

1- Goldfish — 44 Files — The Android emulator runs a virtual CPU that Google calls Goldfish. Goldfish executes ARM926T instructions and has hooks for input and output — such as reading key presses from or displaying video output in the emulator.

These interfaces are implemented in files specific to the Goldfish emulator and will not be compiled into a kernel that runs on real devices. So we safely ignored these files in our work.

2- YAFFS2 — 35 Files — Unlike PCs, which store files on disks, mobile phones store files in sold-state flash memory chips. The HTC G1 uses NAND flash, a type of flash memory that is becoming more popular due to its combination of high density and low cost.
3- YAFFS2 is an acronym for "Yet Another Flash File System, 2nd edition." It provides a high-performance interface between the Linux kernel and NAND flash devices. YAFFS2 was already freely available for Linux. However, it is not part of the standard 2.6.25 Linux kernel, and so Google added it to Android.
4- Bluetooth — 10 files — Google made changes to 10 files in the Bluetooth communications stack. These changes fix apparent bugs related to Bluetooth headsets, and add Bluetooth debugging and access control functions.
5- Scheduler — 5 files — The Android kernel also contains slight changes to the CPU process scheduler and time-keeping algorithms. We don't know the history of these changes, and the impact was not evident based on a cursory examination.
6- New Android Functionality — 28 files — In addition to bug fixes and other small changes, Android contains a number of new subsystems that are worth mentioning here, including the following:
   a- IPC Binder — The IPC Binder is an Inter-Process Communication (IPC) mechanism. It allows processes to provide services to other processes via a set of higher-level APIs than are available in standard Linux. An Internet search indicated that the Binder concept originated at Be, Inc., and then made its way into Palm's software, before Google wrote a new Binder for Android.
   b- Low Memory Killer — Android adds a low-memory killer that, each time it's called, scans the list of running Linux processes, and kills one. It was not clear in our cursory examination why Android adds a low-memory killer on top of the already existing one in the standard Linux kernel.
   c- Ashmem — Ashmem is an Anonymous SHared MEMory system that adds interfaces so processes can share named blocks of memory. As an example, the system could use Ashmem to store icons, which multiple processes could then access when drawing their UI. The advantage of Ashmem over traditional Linux shared memory is that it provides a means for the kernel to reclaim these shared memory blocks if they are not currently in use. If a process then tries to access a shared memory block the kernel has freed, it will receive an error, and will then need to reallocate the block and reload the data.
7- RAM Console and Log Device — To aid in debugging, Android adds the ability to store kernel log messages to a RAM buffer. Additionally, Android adds a separate logging module so that user processes can read and write user log messages.
8- Android Debug Bridge — Debugging embedded devices can best be described as challenging. To make debugging easier, Google created the Android Debug Bridge (ADB), which is a protocol that runs over a USB link between a hardware device running Android and a developer writing applications on a desktop PC.
9- Android also adds a new real-time clock, switch support, and timed GPIO support. We list the impacted files for these new modules at the end of this document.
10- Power Management — 5 files — Power management is one of the most difficult pieces to get right in mobile devices, so we split it out into a group separate from the other pieces. It's interesting to note that Google added a new power management system to Linux, rather than reuse what already existed. We list the impacted files at the end of this document.
11- Miscellaneous Changes — 36 files — In addition to the above, we found a number of changes that could best be described as, 'Miscellaneous.' Among other things, these changes include additional debugging support, keypad light controls, and management of TCP networking.
12- NetFilter — 0 files –Finally, our change list showed Netfilter as having 22 changed files. However, examination showed the only difference was the capitalization of the filenames (xt_DSCP.c vs. xc_dscp.c). The contents of the files were all identical. So we ignored these files in our port."[5]

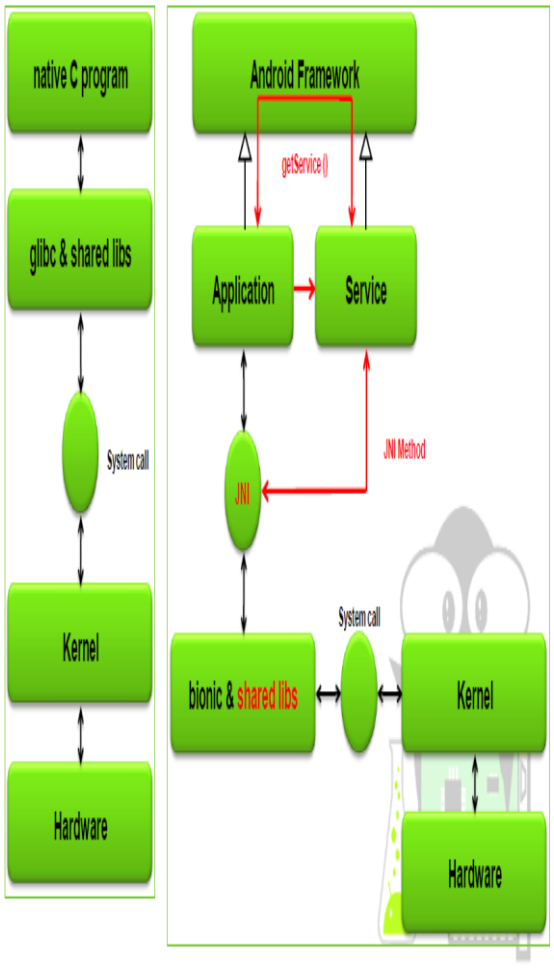

Fig. 1. Traditional Linux Model vs. Android Model[6]

IV. Related works

I. "Android Porting Concepts"

A mobile operating system or a mobile OS is an OS for handheld devices or mobiles. The operating system controls a mobile device—just like Mac OS, Linux or Windows controls a desktop computer or laptop. However, what differentiates them are their light weight applications, their simplicity and how they majorly deal with the wireless versions of broadband and local connectivity, mobile multimedia formats, and different input methods.

Smartphones have the following characteristics:

- They are handy and small.
- Multiple, Frequent and continuous connectivity
- Products diversity
- Open platform
- Limited memory

Smartphones in today's age are found to be based on a number of different Operating Nokia's Symbian OS, Apple's IOS, RIM's BlackBerry OS, Microsoft's Windows Phone OS, Linux, Palm WebOS, Google's Android, Samsung's Bada (operating system) and Nokia's Maemo. Android, Bada, WebOS and Maemo are in turn built on top of Linux, and the iPhone OS is derived from the BSD and NeXTSTEP operating systems, which all are related to UNIX.[7]

II. Design and Implementation of an Android

In the last decade androids have had a great importance in diverse applications, such is the case of the manufacturing industry as well as the handling of hazardous material. One of the functions that we developed was that the android was capable of coming and going to different locations and perform different movements. The decision of going to X location or to Y location depends on the instruction that a code written in VHDL language gives out, this code simulates the android intelligence and decides what should be done. A CPLD (Complex Programmable Logic Device) is a device capable of performing several processes independently and at the same time. Those processes running at the same time inside the same integrated circuit can communicate each other by means of "signals" which represent internal connections inside the same CPLD. For that reason a CPLD was chosen to control all the functions of the android.[8]

III. Android Platform Based Linux Kernal Rootkit

Android with linux kernel is on its way to be a standard platform of various smart devices. Therefore, Android platform based linux kernel rootkit will be a major security threat to smart phones, tablet PCs, smart TVs and so on. Although there is an urgent need of remedy for this threat, no solution or even a suitable study has been announced. In this paper, we are going to depict some rootkits which exploit android kernel by taking advantage of LKM(loadable kernel module) and /dev/kmem device access technology and discuss the danger the rootkit attack would bring.[9]

V. Power Management

Power management in operating systems is necessary due to the ever increasing power demand of modern desktop computers and especially laptops. In order to reduce wasted power, multiple hardware power saving features are employed by Linux such as clock gating, voltage scaling, activating sleep modes and disabling memory cache. Each of these features reduces the system's power consumption at the expense of latency and/or performance. These tradeoffs on a Linux system are managed by either Advanced Power Management (APM) or Advanced Configuration and Power Interface (ACPI). APM is an older, simpler, BIOS based power management subsystem, which is still used on older systems. Newer systems use ACPI based management instead. ACPI is more operating-system centric than APM and also offers more features such as a tree structure for powering down devices so that subsystem components are not turned off before the subsystem itself. [10]

In contrast with a standard Linux system, Android does not use APM, nor ACPI for power management. Android instead has its own Linux power extension, PowerManager instead. The core power driver was added to the Linux kernel in order to facilitate this functionality. This module provides low level drivers in order to control the peripherals supported by the Power Manager. These peripherals currently include: screen display and backlight, keyboard backlight and button backlight. Each peripheral's power is controlled through the use of WakeLocks. These locks are requested through the API whenever an application requires one of the managed peripherals to remain powered on. If no wake lock exists which "locks" the device, then it is powered off to conserve battery life. In the case of multiple power settings the transition is managed through the use of delays based on system activity. Manager also monitors the battery life and status of the device. This service coordinates with the power circuitry charging in the battery and also powers down the system when the battery REACHES A CRITICAL THRESHOLD.[11]

VI. Summary of Differences

1. Android is an open source operating system developed by Android, Inc. which is now owned by Google, Inc. whereas Linux is developed as an open source operating system under the GNU project by Linus Torvalds and many others.
2. Android is developed for Mobile Internet Devices and mobile phones whereas Linux is developed for desktops/laptops/servers.
3. The Android operating system has its own C library called Bionic whereas Linux systems use GNU C library.
4. The Android systems use flash memory instead of hard drives while the standard Linux systems use magnetic drives.
5. The Android systems have their own power manager whereas the Linux systems use APM and ACPI to manage the power.[12]

VII. Conclusions

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