

Building an AOSP based Custom ROM

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Abstract

Mobile phones are a very integral part of our day to day life. But with tech advancing at the rate at which it is, devices tend to go outdated within one or two years since their launch due to a lack of updates, patches and support from the manufacturer, even though they are capable of running for longer than that. This project aims to tackle that issue and increase the lifespan and usability of a device, performance, provide the latest security patches and update it to the latest stable android version. Using Google's Android Open Source Project, we build our own version of the Android Operating System, which will be able to run on older hardware, provide more customizations, etc.

We build a custom android based OS using a Linux based computer with all necessary installations, the AOSP source, device trees and the Android Make Build System (Make/Soong).

Keywords: *- Mobile Phones, Android , Updates, Soong, Custom Rom, Soong, Patches, Linux.*

INTRODUCTION

Android is a mobile operating system based on a modified version of the Linux kernel and other open-source software, designed primarily for touch screen

mobile devices such as smartphones and tablets. Android is developed by a consortium of developers known as the Open Handset Alliance and commercially sponsored by Google. The Android source

code is released in an open-source format to help advance open standards across mobile devices. However, despite being released as “open,” Android is still packaged with proprietary software when sold on handset devices.

One of the most profitable industries in the world is the tech industry, and mobiles contribute to a large chunk of the success. But with new companies and devices emerging on almost a daily basis, the number of problems caused by them also increases. With this project, we expect to

tackle problems such as unauthorized data sharing, phones with outdated security, software and lackluster performance. Once implemented, we can have

- Latest version of Android.
- Latest Security Patches.
- Increased Storage.
- Better RAM management.
- Reduced e-waste due to increased lifespan of phones.
- No bloatware
- Data farming by malicious apps can be avoided

SYSTEM ARCHITECTURE



Figure 1: Android System Architecture

Application Framework

The application framework is used most often by application developers. As a hardware developer, you should be aware of developer APIs as many maps directly to the underlying HAL interfaces and can provide helpful information about implementing drivers.

Binder IPC

The Binder Inter-Process Communication (IPC) mechanism allows the application framework to cross process boundaries and call into the Android system services code. This enables high-level framework APIs to interact with Android system services. At the application framework level, this communication is hidden from the developer, and things appear to "just work".

System Services

System services are modular, focused components such as Window Manager, Search Service, or Notification Manager. Functionality exposed by application framework APIs communicates with system services to access the underlying hardware. Android includes two groups of services: system (such as Window Manager and Notification Manager) and media (services involved in playing and recording media).

Hardware Abstraction Layer (HAL)

A HAL defines a standard interface for hardware vendors to implement, which enables Android to be agnostic about lower-level driver implementations. Using a HAL allows you to implement functionality without affecting or modifying the higher-level system. HAL implementations are packaged into modules and loaded by the Android system at the appropriate time. For details, see Hardware Abstraction Layer (HAL).

Linux Kernel

Developing your device drivers is similar to developing a typical Linux device driver. Android uses a version of the Linux kernel with a few special additions such as Low Memory Killer (a memory management system that is more aggressive in preserving memory), wake locks (a Power Manager system service), the Binder IPC driver, and other features important for a mobile embedded platform. These additions are primarily for system functionality and do not affect driver development. You can use any version of the kernel as long as it supports the required features (such as the binder driver).

ACTIVITY DIAGRAM

Activity diagram is basically a flowchart to represent the flow from one activity to another. The activity can be described as an operation of the system. So, the control flow is drawn from one operation to another. This flow can be sequential, branched or concurrent. The activity diagram deals with all types of flow by using elements like fork and join.

Android Activity Lifecycle is controlled by 7 methods of android.app.Activity class. The android Activity is the subclass of the Context Theme Wrapper class. An activity is a single screen in android. It is like a window or frame of Java. With the help of activity, you can place all your UI components or widgets on a single screen.

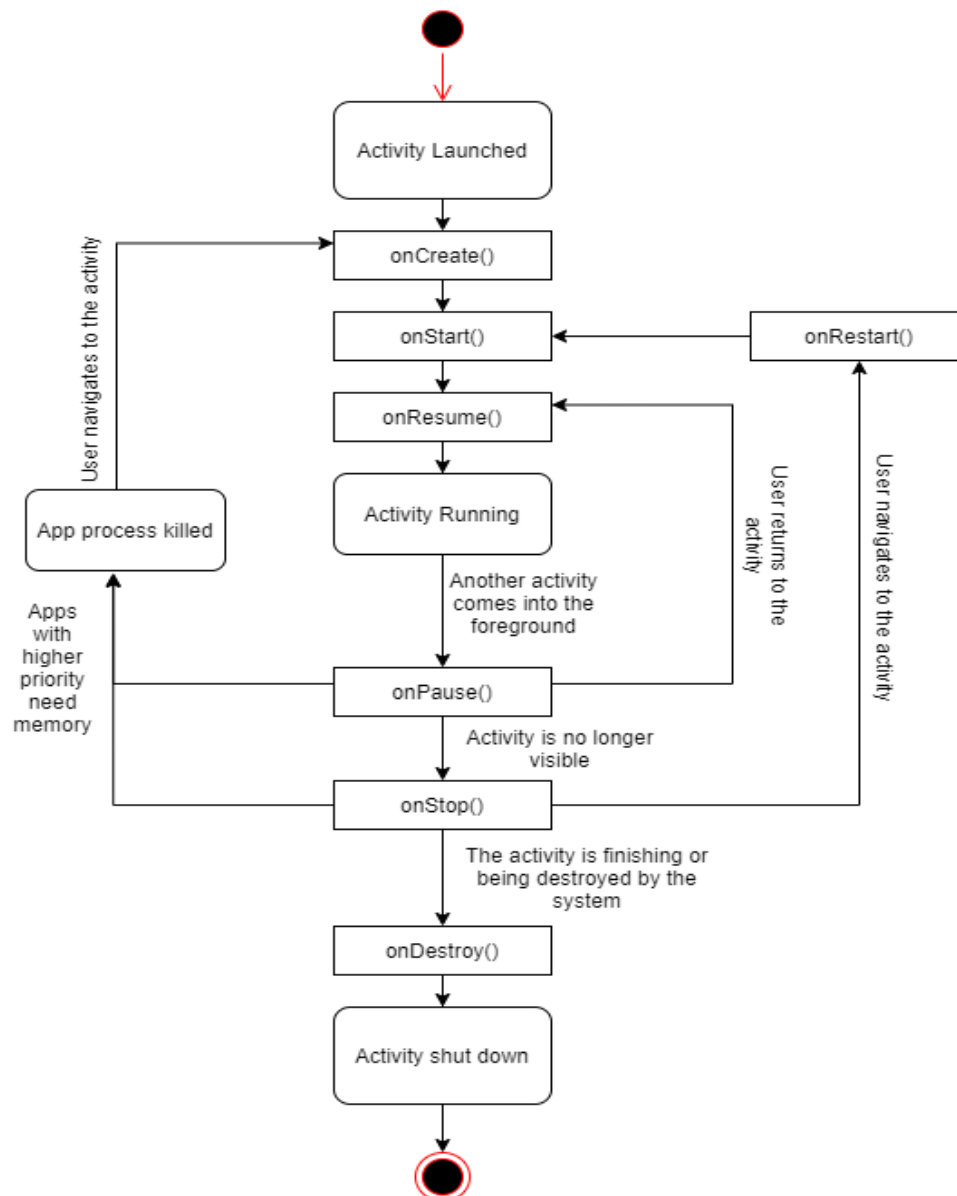


Figure 2: Activity Diagram

LITERATURE SURVEY

A. Android System architecture and application programming

Authors: *Chao Wang, Wei Duan, Jianzhang Ma, Chenhui Wang*

This thesis talks about the architecture of the Android System and its application framework. In the days before, mobile phones were just portable phones which were much smaller. However, in the 21st century, personal computing becomes more personal, computers are becoming more accessible anywhere, at any time.

Mobile Phones are not only portable phones for talking; they have been capable of catching data, watching movies, and surfacing the Internet. It will be the next PC. Along with the development of hardware, the Internet is also developing very fast. Web 2.0 has come, YouTube, Facebook, MySpace, Twitter are now the most popular things.

Cloud computing is not a dream because the speed of the Internet is much faster than ever before. You can put your entire thing on the server instead of your PC. Under this situation, Android comes out. It is a mobile OS developed by Google. The system is open-sourced based on Linux so that it can be developed by developers.

B. Android Operating System

Authors : *Ankit Kumar, Kunal Berry, Rahul Berry, Chandan Sabharwal*

This paper focuses on the Android OS and what are the benefits of the Android Operating System. Android Operating System is the operating system which is designed for mobile operating, and due to the technological development in the field of mobiles, its existence has increased due to the rapid increase of the number of mobiles and tablets in the world, which leads to an increase in its market share. Android Platform is the most popular platform with a rapid increase in the number of new users every year. Google developed Android Operating as part of the Open Handset Alliance, a group of more than 30 mobile and technology companies working together on a mobile handset environment. Android Development kit supports standard packages which are used by the Android Operating System. The Android Operating System is being developed for Open Source Devices.

C. Android Operating System: A Review

Authors: *International Journal of Trend in Research and Development - Krithika .B, Prabhu .S and Visalakshi .S*

Android is a much more diverse operating

system than iOS and Windows Phone Mobile. Android has grown rapidly over the past 4 years, becoming the most used smartphone operating system in the world. It's because Android doesn't release 1 phone from 1 company with 1 new OS every year, but countless phones from numerous companies, adding their own twist throughout the year, developing day-by-day gradually. Android's ability to customize is unparalleled compared to Apple's and Microsoft's software allowing the user to change and customize nearly every aspect of Android, which most iPhone and Windows 7 users wouldn't dream possible. I am not one to say that Android is better or worse than one OS, but it is unique and incomparable to other mobile operating systems.

D. Push Messaging on Android

Authors: *Eng. Rasha el Stohy, Dr. Nashaat el Khamesy, and Dr. Haitham el Ghareeb*

This paper focuses on push notification systems using different technologies while also presenting push messaging across various domains. The research proposes the use of a notification based system on the Android platform. The system is implemented using Eclipse, which has the ability of extensibility and allows the reuse of Android Components to push notifications from web services and third-

party GCM applications, in addition to sending the known SMS. The push notification service can be used in multiple applications simultaneously by making only small modifications. All the services utilized in the proposed solution were evaluated in real Android system devices with good performance results. This research opens up future work to evaluate the extension of the android based on push services to support other new features as well as establish more frameworks in different scenarios.

E. What are custom android roms and how to install them.

Authors: *Lakshay Kumar*

One of the reasons why many Android enthusiasts flock to custom ROMs is that their devices stop getting new software updates after a couple of years, and having a custom ROM offers them the ability to improve functionality and get their hands on the new software.

F. How to build your own custom Android ROM

Authors: *Gary Sims*

Android is a complete operating system. It is complex and contains many different subsystems. Creating an operating system as complex and useful as Android didn't happen overnight. This means that any customization that you wish to perform is

going to have to start small. To create an alternative Android distribution that is radically different will take many, many hours of hard work and dedication.

G. Custom ROM-A Prominent Aspects of Android

Authors: Saurabh Manjrekar, Ramesh Bhati

This paper tries to look behind the wheels of android and keeping the uncommon spotlight on custom ROM, and essentially check for security misconfiguration, which could respect gadget trade-off, which might bring about malware disease or information robbery. Android comprises a portable working framework in view of the Linux bit, with middleware, libraries and APIs written in C and application programming running on an application system that incorporates Java-perfect libraries taking into account Apache Harmony. Android utilizes the Dalvik virtual machine without a moment to spare gathering to run ordered Java code. To gain the full control (administrative control) over the device, an android device can easily be rooted. Rooting is the installation of the custom ROMS in the device. Android is open source; thus, it is easy to access its code. Making the changes in android's official ROM code may result in new ROM's. The user with full administrator control is

known as a superuser. And to be an upper user, a user has to root his/her device.

H. Rooting & Custom Rom in Android

Authors: Pranit A. Kamble and Dr. Jyoti Kharade

This paper focuses on Rooting. Rooting your Android Phone can be very powerful as it gives you the best user-friendly experience and total control on your device. However, the step of rooting and custom ROM on your Android Phone should not be rushed into, and it should be carefully done; the service of an expert should be considered if you lack the experience of similar tasks. The manufacturer would not allow you to uninstall those preinstalled apps on your device. Once you Rooting a device can make them removed easily, which ensures high running quality. A rooted Android can get the new OS months before the carrier releases the update, often along with a few bonus features. Some powerful apps like Greenify can close useless applications automatically, which can effectively improve your device's performance. Of course, Greenify needs root access. A manufacturer of Android mobile can only backup some settings and apps of your device. Titanium can be used on rooted devices to give you a complete backup.

I. Building Custom ROM using AOSP and Improving RAM usage in it

Authors: Chirag Kanthed, Yagyapal Yadav

Building an operating system by Android source is quite challenging, and it is really complex. This research determines that all the processes implemented to build and customize the ROM will result in optimized RAM and also will result in low memory usage for the operating system. Improved RAM usage will result in better application response and good operating system response, and more memory will give access to store more where normally will not be able to store any file. To avoid the extra use of RAM in

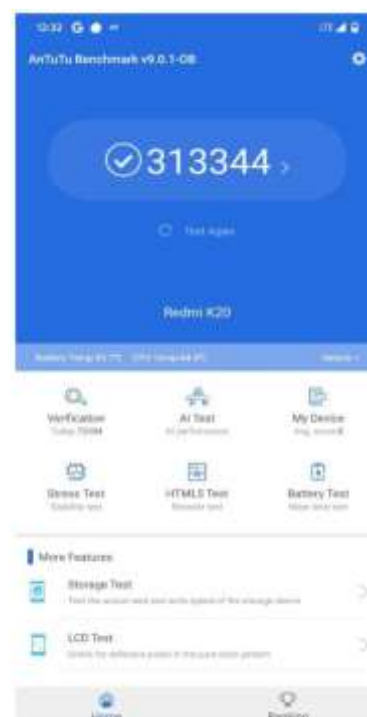
low memory devices, RAM usage must be optimized. It is done by modifying Low Memory Killer Algorithm so that invisible application must be killed so that availability of RAM will increase. In stoke OS the user interface is quite laggy, but in custom ROM, it will provide a lag-free interface. In Stoke ROM, there are lots of API and different applications which are not usually required by the user, but it is there in the system, and that causes battery drain in building custom ROM. Hence those apps will not be added, which is not required because as we will require those apps, we can install them from the Android Market.

RESULTS

A. Benchmark Scores

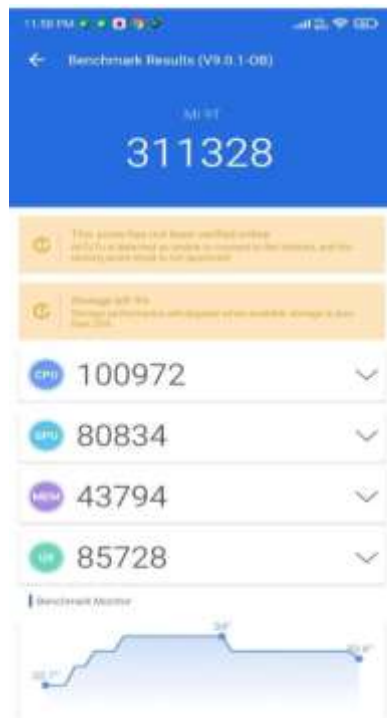


MIUI

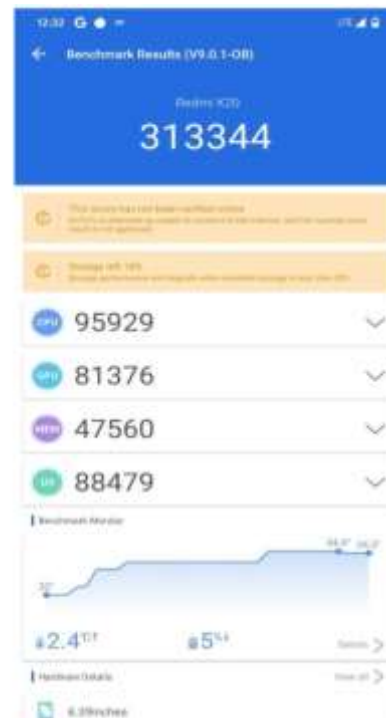


HuskyRom

Benchmark Scores (Full)

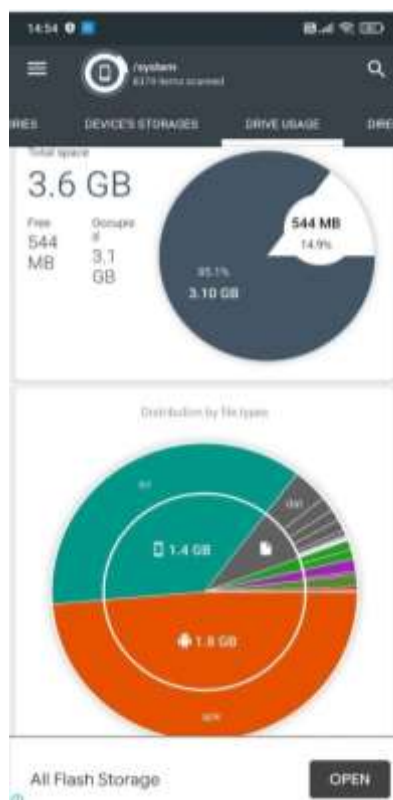


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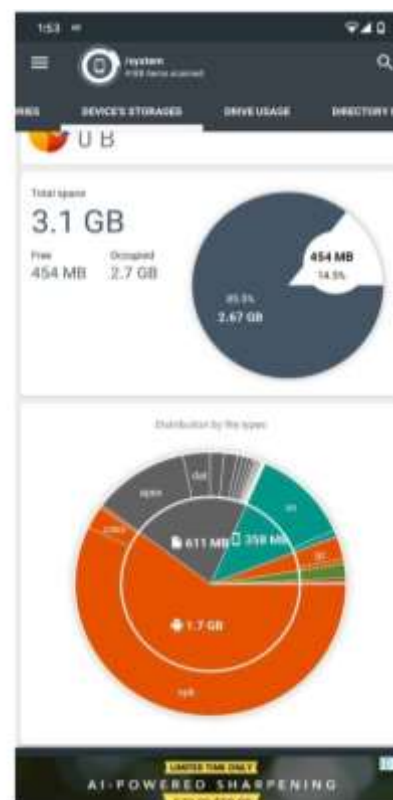


HuskyRom

B. Storage Usage

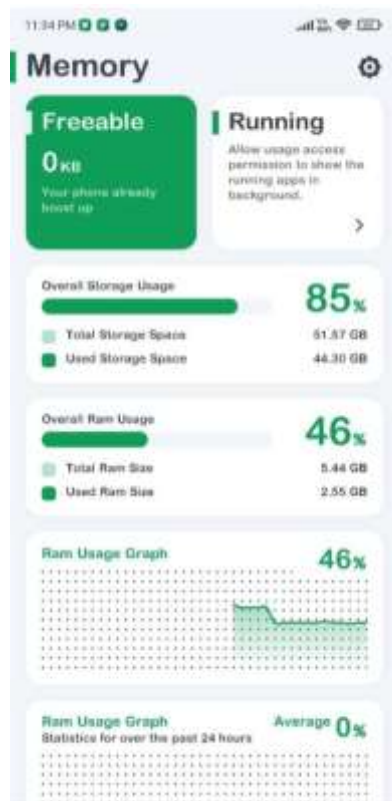


MIUI



HuskyRom

C. RAM Usage



MIUI



HuskyRom

D. Boot Times



MIUI (18.16 Seconds)



HuskyRom (15.89 Seconds)

CONCLUSION AND FUTURE WORK

An AOSP based custom ROM has been built from source and installed. The test device showed significant improvements in speed, memory management, battery life, storage, boot times, etc., while also running the latest stable version of Android (Android 11) with the latest security patches from Google. It also has no bloatware or ads in the interface. Once the ROM is stable enough, we can work on it and build a GSI of the ROM, which will essentially allow us to install and run it on any device which supports Project Treble (All devices that were launched after 2016 support Project Treble). The GSIs will allow individual developers to install the ROM and tweak it for their own device.

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