

Evolution of Android Operating System and it's Versions

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ABSTRACT

Android is a software stack for mobile devices that includes an operating system, middleware and key applications. It can be considered as a software platform as well as an operating system for mobile devices based on the Linux operating system and currently developed by Google. It is designed primarily for touch screens mobile devices such as smartphones and tablet computers. One of the most widely used mobile OS these days is android. It is free and open source software its source code is known as Android Open Source Project (AOSP), which is primarily licensed under the Apache License. This Paper Contains android architecture consists of key applications, Application framework, Native libraries, Android runtime, DVM, Linux Kernal., Many versions of Android Operating System are KitKat, JellyBean, Honeycomb, Froyo etc... Advantages and Disadvantages of Android and also the conclusion.

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KEYWORDS: Android, Android OS Architecture, Android Versions, Dalvik VM

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I. INTRODUCTION:

Android is a mobile operating system running on the Linux kernel. It was initially developed by Android Inc. a firm later purchased by Google, and lately by the Open Handset Alliance. consortium of 47 hardware, software, and telecom companies devoted to advancing open standards for mobile devices. One of the most widely used mobile OS these days is android. It is free and open source software its source code is known as Android Open Source Project (AOSP), which is primarily licensed under the Apache Licenser.

History of Android OS:

Android is described as a mobile operating system, initially developed by Android Inc. Android was sold to Google in 2005. Android is based on a modified Linux 2.6 kernel. Google, as well as other members of the Open Handset Alliance (OHA) collaborated on Android (design, development, distribution). Currently, the Android Open Source Project (AOSP) is governing the Android maintenance and development cycle. In July 2005, Google acquired Android Inc. for at least \$50 million.^[7] Its key employees, including Rubin, Miner and White, joined Google as part of the acquisition.

Not much was known about the secretive Android at the time, with the company having provided few details other than that it was making software for mobile phones. At Google, the team led by Rubin developed a mobile device platform powered by the Linux kernel. Google marketed the platform to handset makers and carriers on the promise of providing a flexible, upgradeable system.



Figure 1. An evolution of Android Operating system

II. ANDROID OPERATING SYSTEM ARCHITECTURE:



Figure 2. Architecture of Android OS

Software stack is split into four layers. That are

- A. Linux kernel
- B. Native Library
- C. Application Framework Layer
- D. Applications
- E. Android Runtime

A. Linux kernel:

Android Architecture is based on Linux 2.6 kernel. It helps to manage security, memory management, process management, network stack and other important issues.^[2] Therefore, the user should bring Linux in his mobile device as the main operating system and install all the drivers required in order to run it. the kernel handles all the things that Linux is really good at such as networking and a vast array of device drivers, which take the pain out of interfacing to peripheral hardware.

B. Native Library:

^[1]On the highest of the Linux kernel there's Native Library layer. Native libraries contain WebKit, OpenGL, Free Type, SQLite, Media, C runtime library (libc) etc. native libraries written in C/C++, that ar to blame for stable performance of assorted parts. SQLite is on-line database and accessible to all or any applications. It manages the access for various processes to compose second and 3D graphic layers. ^[4]OpenGL E and SGL create a core of graphic libraries and are used consequently for 3D and second hardware acceleration. Moreover, it's attainable to use 2Dand 3D graphics within the same application in automaton.

C. Application Framework Layer:

The Android Framework layer exists provides the high-level building blocks you will use to create your applications. The framework comes preinstalled with Android, but you'll conjointly extend it along with your own parts as required.^[3] The Android Framework layer contains Android APIs such as UI (user interface), telephony, resources, locations, content providers (data) and package managers. This layer contains a collection of classes and interfaces for Android application development.

D. Applications:

Android Architecture we have all the applications, which are used by the final user. All applications are written exploitation using the Java programming language. All apps i.e., home, contact, settings, games, browsers are using an android framework that uses android libraries and runtime. This is the layer that end-users interact with. It is on this layer where application developers publish their applications to run. Android, by default, comes with a set of applications that make android devices usable from the offsete)

E. Android Runtime:

Android includes a collection of core libraries that has most of the practicality accessible within the core libraries of the Java artificial language. Every golem application runs in its own method, with its own instance of the Dalvik virtual machine. Dalvik has been written so a tool will run multiple VMs with efficiency. The Dalvik VM executes files within the Dalvik viable (.dex) format that is optimized for borderline memory footprint.

III. DVM (DALVIK VIRTUAL MACHINE):

^[13]Dalvik could be a purpose engineered virtual machine designed specifically for humanoid that was developed by Dan Bornstein and his team. it had been primarily developed for mobile devices. one among the outstanding aspects in Dalvik its capability to along associate application compilation enhancing the runtime performance of the applications. DVM manage the virtual machine for performance, battery and memory.

Working Structure of DVM:

At an equivalent level there's android Runtime, wherever the most element Dalvik Virtual Machine is found. it had been designed specifically for golem running in restricted setting, wherever the restricted battery, CPU, memory and information storage are the most problems. ^[14]android provides associate integrated tool "dx", that converts generated computer memory unit code from.jar to.dex file, when this computer memory unit code becomes way more economical to run on the little processors. because the result, it's doable to own multiple instances of Dalvik virtual machine running on the one device at an equivalent time. The Core libraries ar written in Java language and contains of the gathering categories, the utilities, IO and different tools.

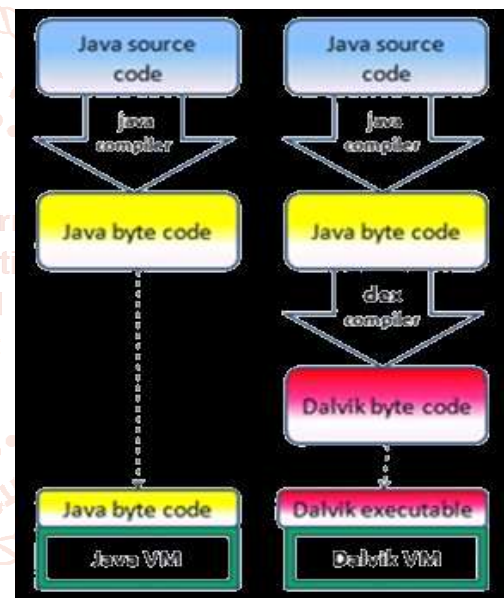


Fig-3: Working of Dalvik virtual Machine

IV. ANDROID VERSION HISTORY:

The development of android started in 2003 by automaton, Inc., that was purchased by Google in 2005. There were a minimum of 2 internal releases of the computer code within Google and therefore the OHA before the beta version was discharged. The beta was discharged on day, 2007 whereas the computer code development kit (SDK) was discharged on Gregorian calendar month twelve, 2007. many public beta versions of the SDK were discharged.^[8] These releases were done through computer code emulation as physical devices failed to exist to check the package. The automaton OS updates principally focuses on new options and fixes bugs. Table shows the evolution of the automaton version. It conjointly shows that the essential versions one.0 and 1.1 haven't any code name and therefore the later version of automaton features a course name and version nine pie stops the course codename system when automaton and starts a system referred to as automaton one0, Android 11.

Name	Version number(s)	Initial stable release date
No official codename	1.0	September 23, 2008
	1.1	February 9, 2009
Cupcake	1.5	April 27, 2009
Donut	1.6	September 15, 2009
Eclair	2.0–2.1	October 26, 2009
Froyo	2.2–2.2.3	May 20, 2010
Gingerbread	2.3–2.3.7	December 6, 2010
Honeycomb	3.0–3.2.6	February 22, 2011
Ice Cream Sandwich	4.0–4.0.4	October 18, 2011
Jelly Bean	4.1–4.3.1	July 9, 2012
KitKat	4.4–4.4.4	October 31, 2013
Lollipop	5.0–5.1.1	November 12, 2014
Marshmallow	6.0–6.0.1	October 5, 2015
Nougat	7.0–7.1.2	August 22, 2016
Oreo	8.0	August 21, 2017
	8.1	December 5, 2017
Pie	9	August 6, 2018
Android 10	10	September 3, 2019
Android 11	11	September 8, 2020
Android 12	12	TBA

Table 1 Version list of Android Operating System

1. Android Version 1.0 to 1.1: No codename:

The first official version of golem debuted publically in 2008 as golem 1.0. the primary unleash failed to even have a codename. It supports browser to point out web content, camera, access internet email server. This version includes Google Calendar, Google Maps, Google synchronize, Google Search, photos (Gallery), Wi-Fi and Bluetooth support.

2. Android version 1.5: Cupcake:

The 2 updated to 1.5 free On April 27, 2009.^[5]The codename of the update was course item (Cupcake). it's UNIX system kernel 2.6.27. This version of android supports third-party virtual keyboard, recording and playback in MPEG-4, Copy and paste feature, Animated screen translations, auto-rotation choice.

3. Android version 1.6: Donut:

Android 1.6 was free On Sep 15, 2009, with the name friedcake. This version includes numerous new options like voice and text entry search, bookmarker history, contacts, web, "speak" a string of text, quicker camera access and user will delete multiple photos in same time, support text-to-speech engine, WVGA screen resolutions.

4. Android version 2.0 to 2.1: Eclair

Android 2.0 was free On October 26, 2009, with codename cream puff. it had been supported UNIX system kernel a pair of 6.29. This contains the various new options like distended account synchronize, Microsoft Exchange email support, ^[2]Bluetooth 15.1, ability to faucet a Contact picture and choose to decision, SMS, ability to go looking all saved SMS, MMS messages, delete the oldest message mechanically once the outlined limit is reached, Minor API, bug fixes.

5. Android version 2.2 to 2.2.3: Froyo

Android 2.2 was free on may 20, 2010. The update was codenamed Froyo. This update relies on the UNIX system kernel 2.6.32. This version introduces several options like speed, memory, performance improvement.

6. Android version 2.3 to 2.3.7: Gingerbread

Android 2.3 version with cake codename was free on Gregorian calendar month 6, 2010. it's supported Linux kernel 2.6.35. This version of android fixes bug fixes for Nexus S, voice or video chat exploitation Google speak,

network performance for Nexus S4G, Gmail application, battery performance, voice search bug, Google Case support for Nexus S4G.

7. Android version 3.0 to 3.2.6: Honeycomb

Android 2011.0 was free on feb 22, 2011. The codename for this version is Honeycomb. it absolutely was the primary Android-based pill on the Linux kernel 2.6.66. This version includes a "holographic" programmer for tablets, associate connected system bar, simplified multitasking sound within the recent application system bar.

8. Android version 4.0 to 4.0.4: Ice Cream Sandwich

Android 4.0.1 was released On October 19, 2011, with codename frozen dessert Sandwich. This was supported Linux kernel 3.0.1. This was the last version of formally support Adobe System Flash player. This version introduces the varied new features: refinements to "Holographic " interface, separation of widgets in a very new tab, integrated screenshot capture, improved error correction on the keyboard, improved copy and paste practicality, build-in photograph editor, spell-checking feature, fastened minor bugs, improvement to graphics, higher camera performance.

9. Android version 4.1 to 4.3.1: Jelly Bean

Google declared the robot 4.1 version of the robot software system at the Google I/O conference on Gregorian calendar month 27, 2012. The codename of the update was candy. This version is predicated on Linux kernel 3.0.31. This version updates several options like power tool programme, enhance accessibility, expandable notification, fastened bug on Nexus 7, one-finger gestures to expand/collapse notifications, lock. screen improvement, for tablet will add multiple user.

10. Android version 4.4 to 4.4.4: KitKat

Android 4.4 version discharged on September 3, 2013 with codename KitKat. Initial code name was "Key Lime Pie". On Oct 31, 2013 Google started on Google's Nexus five. The minimum needed quantity of RAM ought to out there to automaton is 340 MB. the opposite devices with but 512 MB of RAM should report themselves as "low RAM" devices.

11. Android version 5.0 to 5.1.1: Lollipop

In 2014 google unleash redo automaton 5.0 with codename lollipop. On nov 12, 2014 it had been discharged formally. This version introduces several options like redesigned computer program, support for 64-bit CPUs, print preview feature, material style, Project Volta for battery life improvement, over one user accounts, audio input/output through USB devices, be a part of Wi-Fi networks, support for multiple SIM cards, device protection, HD voice calls, native Wi-Fi business support.

12. Android version 6.0 - 6.0.1: Marshmallow

On May 28, 2015 google unleash redo automaton 6.0 with codename "Marshmallow", for Nexus five and Nexus vi phones, Nexus 9 tablet. automaton lunches "Marshmallow" for all automaton devices On Oct 5, 2015. This version includes several new options as App Standby, the Doze mode to avoid wasting battery life, native fingerprint reader support, run-time permission requests, USB-C support, Unicode 7.0 & 8.0 emoji support.

13. Android version 7.0 to 7.1.2: Nougat

Google major unleash for the android OS was the android 7.0 with codename "Nougat". The initial codename for this version was "Android N". It 1st appeared for developer preview on March 9, 2016, with a works image. the ultimate version discharged On August 22, 2016. This version

introduces several new versions file-based encoding, rivet the screen, multi-window support, new knowledge Saver mode.

14. Android version 8.0 to 8.1: Oreo

The eighth major release of the automaton OS was automaton 8.0 with codename "Oreo". It 1st appeared for developer preview on March 21, 2017 and its final developer preview was discharged on July 24, 2017. The fastened version of this releases On August 21, 2017 with several new options like picture-in-picture support, support for Unicode 10.0 emoji (5.0), restructured settings, adoptive icons, notification channels, notification dots, increase boot time, Google Play shield, support Integrated printing, Neural network API, shared memory API, android cookie Go Edition, auto fill framework, automatic light-weight.

15. Android version 9.0: Pie

The ninth major version of the android OS was android 9.0. The codename for this version was "Pie". Google discharged and previewed the primary version on March 7, 2018, and it had been formally discharged on August 6, 2018. a number of the new options of this version area unit that the clock moves to the left facet of the notification bar, screenshots area unit additional, buttons, percentages area unit continuously shown within the show.

16. Android version 10:

The tenth updated version of the android OS is "Android 10". The codename of android ten is android q. Initially, The version of automaton ten was discharged on September 3, 2019. This version includes some new options like permissions to access location, floating setting panel, support for associate degree AV1 video codec, support for biometric identification, support the WPA3 Wi-Fi security.

17. Android 11:

Android 11 is that the huge launch of september OS. it's the 18th version of automaton mobile OS. This version was released on sep,8 2020. The code-naming system of android supported deserts, was stopped in android 10 version. This OS has name as "Android 11".

V. ADVANTAGES AND DISADVANTAGES OF ANDROID:

Advantages:

1. Android is Open source:-

Android is commissioned under apache. Mobile firms modification the code of humanoid to form UI modification a touch bit. Developers have conjointly access to the core code and might build changes to that.

2. Notifications are nicely displayed:-

All the notifications of apps, messages, emails, low battery square measure displayed nicely. Users will access the notification by simply sliding from high to bottom. you'll additionally see the notifications in lock mode.

3. Sharing of internet among devices:-

With a mobile hotspot, you'll share your device web with different devices or with laptop. this could facilitate saving cash additionally. If you living during a house then you'll share your web along with your members of the family and that they don't have to be compelled to obtain separate net packages.

4. Run many apps at the same time:-

If you have got a decent specification phone then you'll smoothly run multiple apps at the same time. you'll hear music whereas victimization Instagram or Facebook.

Disadvantages:

1. Apps run in the background:-

In the older version of android, most apps forever run within the background and are available to foreground as they need. however in new edition of golem apps cannot mechanically come back to foreground. As some apps run within the background then it consumes mobile battery and your device battery vanishes quickly.

2. Google account needed:-

For putting in apps from google play store you would like Gmail account. you furthermore may would like a google account to use different Google product. If you forget Gmail id then your device are often fastened and for unlocking you would like to induce your Gmail account.

3. Virus protection:-

Android isn't sensible at virus protection. Users have rights to transfer and install apps from different external websites and these apps might contain a deadly disease and scarf your knowledge and data. it's additionally noticed that some apps in google play store contain a deadly disease.

VI. CONCLUSION:

This paper is giving information about different version of Android OS and Architecture of Android operating system it consist of Dalvik Virtual machine. Each new version of Android introduces various new features with its release. The android architecture has been discussed in a detail way with there advantages and disadvantages. Application used in android are made with java programming so these applications also provide the security because java is secured language.

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