

Android Architecture and Versions

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Abstract: Android operating system is the most commonly used operating system for mobile devices. It is widely used in mobile phones, tablets. It is an open source and codes are written in java. In android system we can apply 2D and 3D graphics at the same time in an application. This paper is all about the introduction of android, discussion about its birth and later on its architecture and architecture layers that include Linux Kernel layer, Libraries and Android runtime, Application Framework layer, Application layer, Android virtual device, versions of android and discussion about their specific codename.

I. Introduction

The users of devices like mobile phones, tablets etc. are increasing rapidly, so this android operating system become very common and a very important part of life. This is an open source and the codes are written in java, one can also change its android features by just turn on the developer option. The android operating system is also linked with the hardware features like camera, wi-fi, Bluetooth, GPS etc. just by giving some permissions Android Inc. was founded by Andy Rubin in Palo Alto, California, United States in October 2003 with his key employees Chris White, Rich Miner and Nick Sears. Later on, in 17th August 2005, Google purchased Android Inc. Google announces android os development in 2007 and in 2008 HTC launched its first android mobile.

Android is an open source platform based on Linux Kernel 2.6 and it is software based, that includes Dalvik

virtual machine, java libraries, application framework and applications that are build-in and also custom applications

II. Architecture

Android architecture has four layers, Linux Kernel, Libraries and Runtime layer, Application framework, and application layer. The Linux Kernel provides basic services like memory management, process management. The libraries are responsible for the stable performance of the different components and in runtime the main component Dalvik virtual machine is present.

The application framework is in java language and it contains the applications with are already present in our mobile phones like SMS, Google search, phone etc. The application layer is the top most layer and this layer is the final layer.



Figure 1. Architecture

A. Linux Kernel Layer

Android is Linux kernel based and this performs all the basic system activities like management, manages security, network issues and many more problems. This also acts as a layer between the hardware and the rest of the software stack. It holds all the necessary hardware drivers. For example, Bluetooth devices, the kernel provides all the drivers for Bluetooth devices and time to time the drivers are updated.

B. Libraries

This is the second layer of an android architecture and it is very important as these libraries contains Surface Manager, media manager, SQLite, WebKit, OpenGL libraries. These libraries contain various types of data that supports our android device and these are written in C/C++ which supports the stable performance of various components. In android system we can apply 2D and 3D graphics at the same time in an application. The media manages provides a different library for videos, this also gives a recording and playback support to the media and static images files also. For data storage SQLite is also present which handles all the database work and all the operations related to database. WebKit is the same browser used by the Apple's Safari, to fit better in a small size screen and this was modified by Android.

C. Android Runtime

This is at the same level where the libraries are present. This is used to compress things and its main component is Dalvik Virtual Machine and the core libraries are written in java. This is specifically for android systems which run in a limited environment, with limited data storage space, limited battery, CPU, memory etc. Android provides an integrated tool "dx", which converts .jar file into .dex file during the compilation, after this the byte code becomes very small and can be easily run on small processors.

D. Application Framework

The Application Framework layer is written in java language. This layer is a tool kit that all in-build applications use, like Contacts, SMS, voice calls and the applications written by Google and any Android developer. This application layer provides APIs, which are used by the applications for getting notifications, access permissions, sharing of data. This layer consists of Activity Manager, Package Manager, Content provider, Telephony Manager, Resource Manager, Notification Manager etc.

The application manager manages the activities and life cycle of the applications. The package manager keeps all

the details of the applications that are installed in device. Content provider manages sharing data between the application. The telephony manager contains all the APIs related to calling. The resource manager is store the external parts of the application. Notification manager manages the alerts and also display the notification and can also prioritize the sequence of notifications.

E. Application Layer

The application layer is the top most layer of the android architecture and this is used by the final user. By installing different apps the user can make his mobile phone unique and all the applications are written in java, which is then interpreted by Dalvik Virtual machine, which is now replaced by Android Runtime (ART). The most common features like Home, Contacts, Phone, Browser etc. Android provides endless opportunities to its developers.

Android Virtual Device

Every version has different Android Virtual Device. The general idea to create an AVD is to develop applications and you set up this AVD at the minimum version of the Android, so that the application that is developed by the developer can be accessible by any of the version. The AVD is an emulator which actually contains the specific Smartphone OS. This is very convenient for those who does not have their own devices to test their applications. For a better user experience app developers test their apps on different version of android and all major handset available in market. A well tested fully functional app gives developer a good rating on play store which helps get a good market for the app.

Version History

After the first version many versions of Android are launched, and every new version has some advance features of the previous version, the bugs in the previous versions are fixed in the next one. The very first version introduced is 1.1 in February 9, 2009 and has API level 2. Since version 1.5 the Android versions have some codenames and these codenames are alphabetical and are names after desserts like cupcake, donut, éclair etc.

Code name	Version number	Initial release date	API level
Cupcake	1.5	April 27, 2009	3
Donut	1.6	September 15, 2009	4
Éclair	2.0 – 2.1	October 26, 2009	5 – 7
Froyo	2.2 – 2.2.3	May 20, 2010	8
Gingerbread	2.3 – 2.3.7	December 6, 2010	9 – 10
Honeycomb	3.0 – 3.2.6	February 22, 2011	11 – 13
Ice Cream Sandwich	4.0 – 4.0.4	October 18, 2011	14 – 15
Jelly Bean	4.1 – 4.3.1	July 9, 2012	16 – 18
KitKat	4.4 – 4.4.4	October 31, 2013	19 – 20
Lollipop	5.0 – 5.1.1	November 12, 2014	21 – 22
Marshmallow	6.0 – 6.0.1	October 5, 2015	23
Nougat	7.0 – 7.1.2	August 22, 2016	24 -25
Oreo	8.0	August 21, 2017	26

Table 1. Versions of Android

- Android Astro 1.0

First commercial android version, In term of networking it supports Wi-Fi as well as Bluetooth, Performance was not up to the mark, Web browser did not support basic features like copy and paste.

- Android Cupcake 1.5

Auto-rotation display option, An advanced web browser that can easily copy & paste text, Give a boost to Speed & Performance.

- Android Donut 1.6

Voice search and Search box were added, Decreased Operating System boot time and Enhanced version of web browser is present for better web browsing experience. On screen keyboard is not quite satisfying as it is quite slow.

- Android Eclair 2.0/2.1

Bluetooth 2.1 support, Improved typing experience with smart dictionary, did not support Flash Media Files.

- Android Froyo 2.2

Flash media files supported, A better Application launcher was available, Web browsing is quite good as comparing from last versions, No internet calling.

- Android Gingerbread 2.3

Updated Application launcher for a better UI, Internet calling is available, Copy & paste feature is available, Updated version of keyboard for faster input and a better smart dictionary, more successful than previous versions, can only works on single core processor.

- Android Honeycomb 3.0

It support Multi-core processors, Ability to convert all user data into codes for a safer access, Not available for Table.

- Android IceCream Sandwich (ICS) 4.0

On screen(virtual) buttons in User Interface, A new typeface family for the UI, Roboto. Ability to auto shut down apps that are using memory and data in the background.

- Android jellybean 4.1

Enhanced user interface, Improved Google Search with a updated search bar, A update and better version of keyboard, Expandable Notifications in Notification bar.

- Android KitKat

Updated Google Now, Hangouts app upgraded for a better chatting and video calling experience, Smarter Caller ID to block spam callers, Integrated with Google’s cloud storage, Printing on the Go via LAN or Wi-Fi, Sensors like Proximity, Gyroscope and compass available, Lock screen Screensavers available. Better memory and RAM management

- Android Lollipop

Smart Lock than can be open with trusted Bluetooth devices, Guest account available and multiple user account supported. Application Screen Pinning for Restricting Use, Automatic Data Encryption to keep data safe. Better Malware Protection via SELinux Enforcement.

- Android Marshmallow

Google Now open on single home button tap, Case-by-case app permissions, Security like Fingerprint sensors support, Type-C USB for better and faster transfer of media, Google Chrome web browser work inside other google as well as other developers app.

- Android Nougat

Multiscreen or we can say Split Screen Mode for better

multitasking, double tap overview button for quick toggle between running apps, Notification plate can be customized, User Interface Tuner available, Powerful battery saving mode with a better power notification, now users can choose different pictures or pre-installed wallpapers for lock and home screen, A better display experience with customizable display size, A hidden Easter egg surprise.

- Android Oreo

Picture in Picture available, Wi-Fi improved, Notification dots, Autofill passwords, Better power and RAM management.

How to be safe

Android is an open source so the codes are easily accessible, and this invites the attention of the hackers. To avoid this a user can download the things from official websites and trusted app store only like Google Play.

Users should check the permissions first before downloading anything. Users are suggested to use antivirus applications.

Users should pay attention to the reviews given by other users. Users should read all the instructions carefully before agreeing to it.

III. Conclusion

Rapid increase in smartphone market as well as other smart devices makes Android most powerful and favourite operating system among all smart device and mobile manufacturers. Based on Linux kernel 2.6 with some further architectural modification Android operating system is divided into four layers and each lower layer provides services to its upper layer. DVM is now replaced by new Android Runtime ART for performance enhancement. Android released a number of versions of the operating system where flaws and bugs in previous versions are fixed and some new features are added. These versions are named in alphabetical order.

References

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