

Google Android: An Emerging Innovative Software Platform For Mobile Devices

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Abstract

In this time of immense globalization the need for Collaborative tools and devices are the bear necessity of life. The increasing importance of mobile devices has triggered intense competition among technology giants, like Symbian, Google, Microsoft, Apple, and Nokia in a bid to capture the bigger market share for mobile platform. Android, an open source mobile platform with no upfront fees, has emerged as a new mobile development option that offers many benefits over competing platforms. “Without continual growth and progress, such words as improvement, achievement, and success have no meaning.” -Benjamin Franklin Google seems to follow this quote very well. A continuous growth and progress have become motto of this industry. Each and every day, it is willing to provide new features, applications, new Interface to their customers. Android brings Internet-style innovation and openness to mobile phones. Android devices are the array of gadgets offering sensor-based capabilities that let developers and users to control applications and games. Android remains the world's most widely used operating system, based on market and usage share statistics, used by hundreds of millions of customers worldwide. Android's Google Play beats App Store with over 1 million apps, now officially largest. Android continued to increase its lead, garnering 79 percent of the market in 2013. In this paper I will review android as a Platform, its current market share, sensors which are important for creating innovative applications and architecture of android as mobile device platform.

Keywords: Android; Architecture of Android; Mobile Operating System; OHA; Open source software platform; Sensors in android.

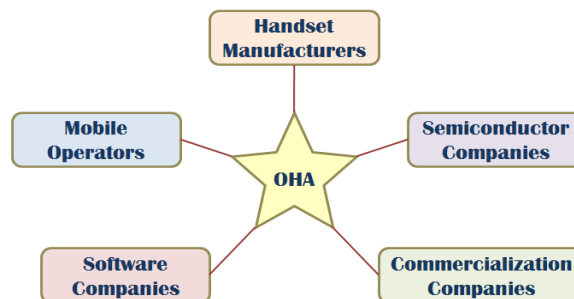
I. INTRODUCTION

The term “Android” has its origin in the Greek word andr-, meaning “man or male” and the suffix -eides, used to mean “alike or of the species”. This together means as much as “being human”.

Android is a software stack for mobile devices which includes an operating system, middleware and key applications. Android is a software stack for mobile devices which means a reference to a set of system programs or a set of application programs that form a complete system.

II. HISTORY OF ANDROID

It is all started with acquisition of Android Inc. by Google in the year 2005. On 5 November 2007, the Open Handset Alliance (OHA) was formed to promote a free open-source operating system based on Linux for mobile devices and Android code was launched under Free/Open Software license. The Open Handset Alliance is a consortium of dozens of technology and mobile telephone companies, including Intel Corporation, Motorola, Inc., NVIDIA Corporation, Texas Instruments Incorporated, LG Electronics, Inc., Samsung Electronics, Sprint Nextel Corporation, and T-Mobile (Deutsche Telekom).



The first phone to feature the new operating system was the T-Mobile G1, released on Oct. 22, 2008.

A. Versions of android



1) *Android 1.5 Cupcake (API level 1)*

Android 1.0, the first commercial version of the software, was released on 23 September 2008. The first commercially available Android device was the HTC Dream.

2) *Android 1.6 Donut (API level 4)*

On 9 February 2009, the Android 1.6 update was released, initially for the HTC Dream only. Android 1.1 was known as "Petit Four" internally, though this name was not used officially.

3) *Android 2.0 Eclair (API level 5)*

On 26 October 2009, the Android 2.0/2.0.1/2.1 SDK – codenamed Eclair – was released based on Linux kernel 2.6.29.

4) *Android 2.2–2.2.3 Froyo (API level 8)*

On 3 December 2009, the Android 2.2 update was released

5) *Android 2.3–2.3.2 Gingerbread (API level 9)*

On 6 December 2010, the Android 2.3 (Gingerbread) SDK was released, based on Linux kernel 2.6.35.

6) *Android 3.0 Honeycomb (API level 11)*

On 22 February 2011, the Android 3.0 (Honeycomb) SDK – the first tablet-only Android update – was released, based on Linux kernel 2.6.36. The first device featuring this version, the Motorola Xoom tablet, was released on 24 February 2011.

7) *Android 4.0–4.0.2 Ice Cream Sandwich (API level 14)*

The SDK for Android 4.0.1 (Ice Cream Sandwich), based on Linux kernel 3.0.1, was publicly released on 19 October 2011. Google's Gabe Cohen stated that Android 4.0 was "theoretically compatible" with any Android 2.3.x device in production at that time. The source code for Android 4.0 became available on 14 November 2011. Ice Cream Sandwich was the last version to officially support Adobe Systems' Flash player.

8) *Android 4.1 Jelly Bean (API level 16)*

Google announced Android 4.1 (Jelly Bean) at the Google I/O conference on 27 June 2012. Based on Linux kernel 3.0.31, Jelly Bean was an incremental update with the primary aim of improving the functionality and performance of the user interface. The performance improvement involved "Project Butter", which uses touch anticipation, triple buffering, extended sync timing and a fixed frame rate of 60 fps to create a fluid and "buttery-smooth" UI. Android 4.1 Jelly Bean was released to the Android Open Source Project on 9 July 2012, and the Nexus 7 tablet, the first device to run Jelly Bean, was released on 13 July 2012.

9) *Android 4.4 KitKat (API level 19)*

Google announced Android 4.4 KitKat, internally known as Project Svelte, on 3 September 2013. The release had long been expected by technology bloggers to be numbered 5.0 and called "Key Lime Pie". KitKat debuted on Google's Nexus 5 on 31 October 2013, and has been optimised to run on a greater range of devices than earlier Android versions, having 512 MB of RAM as a recommended minimum. The required minimum amount of RAM available to Android is 340 MB, and all devices with less than 512 MB of RAM must report themselves as "low RAM" devices.

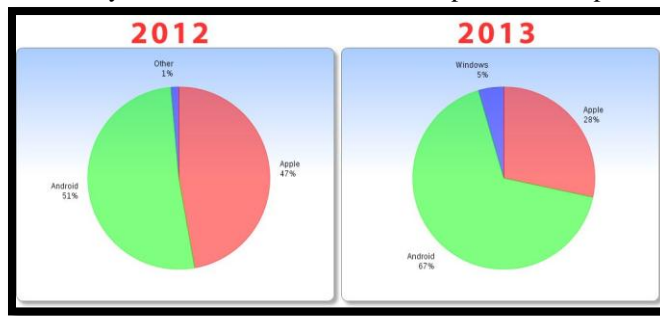
B. Features of Android

Android-based phones require the latest third-generation (3G) wireless networks in order to take full advantage of all the system's "Smartphone" features, such as one-touch Google searches, Google Docs, Google Earth, and Google Street View.

- Display
Adaptable to both larger VGA, 2D graphics library, 3D graphics library based on OpenGL ES 1.0 specifications and regular Smartphone layouts
- Connectivity
Support for GSM/EDGE, CDMA, EV-DO, UMTS, Bluetooth, and Wi-Fi
- Messaging
SMS, MMS, and XMPP
- Java Virtual Machine
Dalvik virtual machine
- Media support
MPEG-4, H.264, MP3, AAC, AMR, JPEG, PNG, GIF
- Browser – based on webkit
- Storage - SQLite
- Hardware support
Touchscreens, GPS, compasses, accelerometers, video/still cameras, and accelerated 3D graphics
- Development tools
Eclipse based IDE with emulator support

III. ANDROID MARKET

For the past few years, Apple has dominated the mobile device market. The iPhone and iPad have been the most widely recognized and popular devices among users worldwide. But the tables appear to be turning. In the past couple of years, Android sales have begun to surge ahead. And this year, Android tablet sales are expected to eclipse iPad sales.



This time last year Apple iPad's and Android tablets had almost a 50-50 share of the tablet market, but a year on and the picture looks very different. A new report from Strategy Analytics has shown that in the second quarter of 2013 Apple's iPad range only accounted for **28 per cent** on the tablet market - **down from 47 per cent** in the same quarter last year. Google's Android platform now has a **67 market share** of the tablet market, up from 51 per cent a year earlier. A larger portion of that success is due to Google's own Nexus 7 tablet, which has gone down a storm with consumers thanks to the great value it offers.

Worldwide Smartphone Sales to End Users by Operating System in 2013 (Thousands of Units)

Operating System	2013 Units	2012 Units
Android	758,719.9	451,621.0
iOS	150,785.9	130,133.2
Microsoft	30,842.9	16,940.7
BlackBerry	18,605.9	34,210.3
Other OS	8,821.2	47,203.0
Total	967,775.8	680,108.2

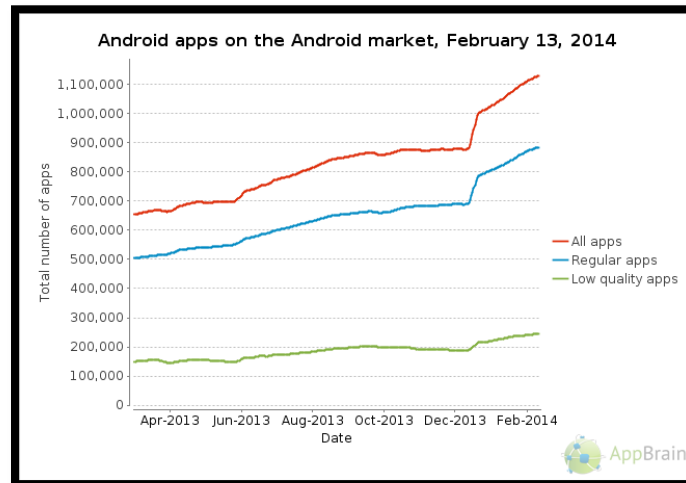
In the smartphone OS market, Android's share grew 12 percentage points to reach 78.4 percent in 2013

Worldwide Smartphone Sales to End Users by Operating System in 2013 (Market Share)

Operating System	2013 Market Share (%)	2012 Market Share (%)
Android	78.4	66.4
iOS	15.6	19.1
Microsoft	3.2	2.5
BlackBerry	1.9	5.0

Other OS	0.9	6.9
Total	100.0	100.0

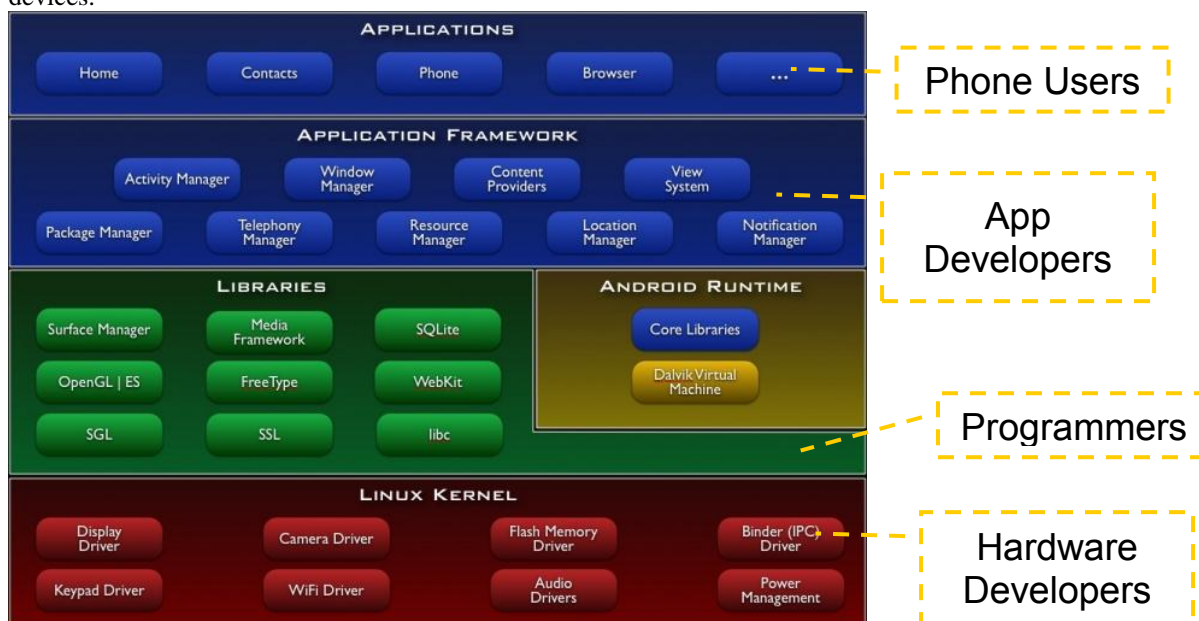
In terms of sales, the two biggest markets for Android and iOS devices are China and the USA. The leading OS in both these markets is Android.



[Current number of Android apps in the market: 11, 32,053]

IV. ANDROID ARCHITECTURE

Android is a Linux-based, open-source operating system designed for use on cell phones, e-readers, tablet PCs, and other mobile devices.



A. Linux Kernel

The basic layer is the Linux kernel. The whole Android OS is built on top of the Linux 2.6 Kernel with approximately 115 patches and with some further architectural changes made by Google. This provides basic system functionality like process management, memory management, device management like camera, keypad, display etc. It is this Linux that interacts with the hardware and contains all the essential hardware drivers. Drivers are programs that control and communicate with the hardware. For example, consider the Bluetooth function. All devices has a Bluetooth hardware in it. Therefore the kernel must include a Bluetooth driver to communicate with the Bluetooth hardware. The Linux kernel also acts as an abstraction layer between the hardware and other software layers.

B. Libraries

The next layer is the Android's native libraries. It is layer that enables the device to handle different types of data. These libraries are written in c or c++ language and are specific for a particular hardware.

Some of the important native libraries include the following:

- Surface Manager: It is used for compositing window manager with off-screen buffering. Off-screen buffering means you can't directly draw into the screen, but your drawings go to the off-screen buffer. There it is combined with other drawings and form the final screen the user will see. This off screen buffer is the reason behind the transparency of windows.
- Media framework: Media framework provides different media codec allowing the recording and playback of different media formats
- SQLite: SQLite is the database engine used in android for data storage purposes.
- WebKit: It is the browser engine used to display HTML content.
- OpenGL: Used to render 2D or 3D graphics content to the screen.

C. Android Runtime

This is the third section of the architecture and available on the second layer from the bottom. Android Runtime consists of Dalvik Virtual machine and Core Java libraries.

Dalvik Virtual Machine is a type of JVM used in android devices to run apps and is optimized for low processing power and low memory environments. Unlike the JVM, the Dalvik Virtual Machine doesn't run .class files, instead it runs .dex files. .dex files are built from .class file at the time of compilation and provide higher efficiency in low resource environments. The Dalvik VM allows multiple instance of Virtual machine to be created simultaneously providing security, isolation, memory management and threading support. The Dalvik VM enables every Android application to run in its own process, with its own instance of the Dalvik virtual machine. It is developed by Dan Bornstein of Google.

Core libraries which enable Android application developers to write Android applications using standard Java programming language. However these libraries provide most of the functionalities defined in the Java SE libraries.

D. Application Framework

The Application Framework layer provides many higher-level services to applications in the form of Java classes. These programs manage the basic functions of phone like resource management, voice call management etc. Application developers are allowed to make use of these services in their applications.

Important blocks of Application framework are:

- Activity Manager: Manages the activity life cycle of applications
- Content Providers: Manage the data sharing between applications
- Telephony Manager: Manages all voice calls. We use telephony manager if we want to access voice calls in our application.
- Location Manager: Location management, using GPS or cell tower.
- Resource Manager: Manage the various types of resources we use in our Application.

E. Applications

You will find all the Android application at the top layer. You will write your application to be installed on this layer only. Several standard applications come pre-installed with every device, such as:

- SMS client app
- Dialler
- Web browser
- Contact manager

As a developer we are able to write an app which replace any existing system app. That is, you are not limited in accessing any particular feature. You are practically limitless and can whatever you want to do with the android (as long as the users of your app permits it). Thus Android is opening endless opportunities to the developer.

V. SENSORS IN ANDROID

A sensor (also called detector) is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument.

The Android platform supports three broad categories of sensors:

A. Motion sensors

These sensors measure acceleration forces and rotational forces along three axes. The Android platform provides several sensors that let you monitor the motion of a device.

Motion sensors are useful for monitoring device movement, such as tilt, shake, rotation, or swing.
Hardware-based:

The Accelerometer and Gyroscope
Either hardware-based or software-based:
The gravity, linear acceleration, and rotation vector sensors

B. Environmental sensors

These sensors measure various environmental parameters, such as ambient air temperature and pressure, illumination, and humidity near an Android-powered device. This category includes barometers, photometer and thermometers.

C. Position sensors

These sensors measure the physical position of a device. This category includes geomagnetic field sensor, orientation sensors.

- (1) ACCELEROMETER
- (2) GYROSCOPE
- (3) MAGNETIC_FIELD
- (4) LIGHT
- (5) PRESSURE
- (6) AMBIENT_TEMP
- (7) RELATIVE_HUMIDITY
- (8) PROXIMITY
- (9) LINEAR_ACCELERATION
- (10) GRAVITY
- (11) ROTATION_VECTOR
- (12) TEMPERATURE
- (13) ORIENTATION

D. Applications that uses sensing features

- 1) *Air Call Accept app:*
 - With this app, you can effortlessly answer or reject your phone calls without even touching it!
 - Using the proximity sensor on your phone, it detects when you wave your hand over the screen or when you place the phone to your ear
- 2) *Motion Detector:*
 - Use of the accelerometer.
 - This application senses every little shake or wobbles of the phone, and plots it out on a graph.
- 3) *Altimeter :*
 - Contains a barometric sensor (to help with GPS).
 - It actually uses either the barometric or GPS sensor, so there's dual fallback in case you need to land that plane in an emergency.
- 4) *Thermometer :*
 - Uses the internal temperature sensor, GPS and an Internet based weather service to provide both inside and outside temperatures in C or F.
- 5) *Light Meter:*
 - It provides a light intensity meter which measures lux.
 - The app uses the integrated light sensor in your phone.
 - It can measure from 0 to 1000 lux in 2 ranges.

VI. CONCLUSION

Smartphones are rapidly becoming a dominant computing platform. Android been open-source software has not only created numerous possibilities with its many potential benefits such as: almost unlimited applications, growing popularity and dependability but also become one of the top in the market. In this work we have reviewed details of Android, market share & studied features as well as Sensors of android for mobile devices. We have also studied Android Architecture. Findings of this review are that Android is superior compare to its competitive systems & acts as “An Emerging Innovative Software Platform for Mobile Devices.” Android is a leader in mobile Platform.

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