



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 2 Issue: XI Month of publication: November 2014

DOI:

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Android Operating System

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Abstract — *The android operating system is basically an operating system for mobiles and is rapidly gaining market share, with dozens of smart phones and tablets either released or set to be released. It is mobile operating system that uses a modified version of the Linux kernel 2.6. Google developed Android as part of the Open Handset Alliance, a group of more than 30 mobile and technology companies working to open up the mobile handset environment. Android's development kit supports many of the standard packages used by Jetty, due to that fact and Jetty's modularity and light weight foot print, it was possible to port Jetty to it so that it will be able to run on the Android platform.*

Keywords— *android, operating system, alliance, Google, Linux*

I. INTRODUCTION

Android is a software platform and operating system for mobile devices, based on the Linux kernel, and developed by Google and later the Open Handset Alliance. It allows developers to write managed code in the Java language, controlling the device via Google developed Java libraries. Android is available as open source. Android is freely downloadable open source software stack for mobile devices that includes an operating system, middleware and key applications based on Linux and Java. Google purchased the developer of Android in 2005, and Android was unveiled in 2007. Google released the Android code as open source under the Apache License. Android has numerous developers writing applications (apps) all over the world. First of all the developers write their script in Java, and then download heaps from the third party sites or online stores. In February 2012, 450,000 appeared available for Android but the estimated number of downloads since December, 2011 was more than 10 billion. There are over 300 million Androids in use and over 850,000 devices activated every day. Android is the one of the most used mobile operating system with a market share of 48% and over 400,000 applications available in Google play store. Android apps have been installed over 10 billion times and cover a vast range of categories from games and entertainment to financial and business services. Android software development and the Google Play Market are relatively open and unrestricted. This offers both developers and users more flexibility and freedom, but also creates significant security challenges.

II. HISTORY

A. Android Inc. founded in 2003

Android, Inc. was founded in Palo Alto, California, United States in October, 2003 by Andy Rubin (co-founder of Danger), Rich Miner (co-founder of Wildfire Communications, Inc.), Nick Sears (once VP at T-Mobile), and Chris White (headed design and interface development at WebTV) to develop, in Rubin's words "...smarter mobile devices that are more aware of its owner's location and preferences." Despite the obvious past accomplishments of the founders and early employees, Android Inc. operated secretly, admitting only that it was working on software for mobile phones.

B. Android Inc. acquired by Google

Google acquired Android Inc. in August, 2005, making Android Inc. a wholly owned subsidiary of Google Inc. Key employees of Android Inc., including Andy Rubin, Rich Miner and Chris White, stayed at the company after the acquisition. Not much was known about Android Inc. at the time of the acquisition, but many assumed that Google was planning to enter the mobile phone market with this move.

C. Development accelerates

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 premise of providing a flexible, upgradable system. Google had lined up a series of hardware component and software partners and signalled to carriers that it was open to various degrees of cooperation on their part. Speculation about Google's intention to enter the mobile communications market continued to build through December 2006/Reports from the BBC and *The Wall Street Journal* noted that Google wanted its search and applications on mobile phones and it was working hard to deliver that. Print and online media outlets soon reported rumours that Google was developing a Google-branded handset. Some speculated that as Google was defining technical specifications, it was showing prototypes to cell phone manufacturers and network operators. In September 2007, *InformationWeek* covered an E-value serve

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study reporting that Google had filed several patent applications in the area of mobile telephony.

D. Open Handset Alliance

"Today's announcement is more ambitious than any single 'Google Phone' that the press has been speculating about over the past few weeks. Our vision is that the powerful platform we're unveiling will power thousands of different phone models." Eric Schmidt, *former Google Chairman/Cocoon* on the November 5, 2007 the Open Handset Alliance, a consortium of several companies which include Broadcom Corporation, Google, HTC, Intel, LG, Marvell Technology Group, Motorola, NVidia, Qualcomm, Samsung Electronics, Sprint Nextel, T-Mobile and Texas Instruments unveiled itself. The goal of the Open Handset Alliance is to develop open standards for mobile devices. On the same day, the Open Handset Alliance also unveiled their first product, Android, a mobile device platform built on the Linux kernel version 2.6. On December 9, 2008, 14 new members joined, including ARM Holdings, A thermos Communications, Austen Computer Inc., Garmin Ltd, Packet Video, Softbank, Sony Ericsson, Toshiba Corp, and Vodafone Group Plc.

E. Licensing

With the exception of brief update periods, Android has been available under a free software/open source license since 21 October 2008. Google published the entire source code (including network and telephony stacks) under an Apache License. Google also keeps the reviewed issues list publicly open for anyone to see and comment. Even though the software is open-source, device manufacturers cannot use Google's Android trademark unless Google certifies that the device complies with their Compatibility Definition Document (CDD). Devices must also meet this definition to be eligible to license Google's closed-source applications, including Android Market. In September 2010, Skyhook Wireless filed a lawsuit against Google in which they alleged that Google had used the compatibility document to block Skyhook's mobile positioning service (XPS) from Motorola's Android mobile devices. In December 2010 a judge denied Skyhook's motion for preliminary injunction, saying that Google had not closed off the possibility of accepting a revised version of Skyhook's XPS service, and that Motorola had terminated their contract with Skyhook because Skyhook wanted to disable Google's location data collection functions on Motorola's devices, which would have violated Motorola's obligations to Google and its carriers.

III. ANDROID SECURITY

The open nature of Android and its large user base have made it an attractive and profitable platform to attack. Common exploits and tool kits on the OS can be utilized across wide number of devices, meaning that attackers can perform exploits en masse and re-use attack vectors. Google did take measures in the development of the android kernel to build security measures in; the OS is sandboxed, preventing malicious processes from crossing between applications. Whilst this attempt to eliminate the concept of infection is admirable in some regards, it fails to address the issue of infection altogether. Android is a victim of its own success, not just in the way it has attracted malicious attention, but in its very nature. One of the reasons the OS has succeeded in gaining market share so rapidly is that it is open source; it is essentially free for manufacturers to implement. Additionally this has led to substantial fragmentation of Android versions between devices and means that vendors have been reluctant to roll-out updates, presumably out of some concern regarding driving demand for future devices.

IV. SERVICE

A Service is code that is long lived and runs without a UI. A good example of this is a media player playing songs from a play list. In a media player application, there would probably be one or more activities that allow the user to choose songs and start playing them. However, the music playback itself should not be handled by an activity because the user will expect the music to keep playing even after navigating to anew screen. In this case, the media player activity could start a service using Context. Start Service () to run in the background to keep the music going. The system will then keep the music playback service running until it has finished. Note that you can connect to service (and start it if it's not already running) with the Context bind service method. When connected to a service, you can communicate with it through an interface exposed by the service. For the music service, this might allow you to pause, rewind, etc.

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V. FEATURES

- A. *Storage*: SQLite, a light weight relational database, is used for data storage purposes.
- B. *Connectivity*: Android supports connectivity technologies including GSM EDGE, IDEN, CDMA, EVDO, UMTS, Bluetooth, WI-Fi, LTE, NFC and WIMAX.
- C. *Messaging*: SMS and MMS are available forms of messaging, including threaded text messaging and Android Cloud to Device Messaging (C2DM) and now enhanced version of C2DM, Android Google Cloud Messaging (GCM) is also a part of Android Push Messaging service.
- D. *Multiple language support*: Android supports multiple languages.
- E. *Web browser*: The web browser available in Android is based on the opensource Web Kit layout engine, coupled with Chrome's V8 JavaScript engine. The browser scores 100/100 on the Acid3 test on Android 4.0.
- F. *Java support*: While most Android applications are written in Java, there is no Java Virtual Machine in the platform and Java byte code is not executed. Java classes are compiled into Dali executable and run on Dali, a specialized virtual machine designed specifically for Android and optimized for battery-powered mobile devices with limited memory and CPU. J2ME support can be provided via third party applications.
- G. *Multi-touch*: Android has native support for multi-touch which was initially made available in handsets such as the HTC Hero. The feature was originally disabled at the kernel level (possibly to avoid infringing Apple's patents on touchscreen technology at the time). Google has since released an update for the Nexus One and the Motorola Droid which enables multi-touch natively.
- H. *Bluetooth*: Supports A2DP, AVRCP, sending files (OPP), accessing the phonebook (PBAP), voice dialling and sending contacts between phones. Keyboard, mouse and joystick (HID) support is available in Android 3.1+, and in earlier versions through manufacturer customizations and third -party applications.
- I. *Tethering*: Android supports tethering, which allows a phone to be used as wireless/wired Wi-Fi hotspot. Before Android 2.2 this was supported by third party applications or manufacturer customizations.
- J. *Screen capture*: Android supports capturing a screenshot by pressing the power and volume-down buttons at the same time. Prior to Android 4.0, the only methods of capturing a screenshot were through manufacturer and third-party customizations or otherwise by using a PC connection (DDMS developer's tool). These alternative methods are still available with the latest Android

VI. LINUX COMPATIBILITY

Android's kernel was derived from Linux but has been altered by Google outside the main Linux kernel tree. Android does not have a native X Window System nor does it support the full set of standard GNU libraries, and this makes it difficult to port existing GNU/Linux applications or libraries to Android. However, support for the X Window System is possible. Google no longer maintains the code they previously contributed to the Linux kernel as part of their Android effort, creating a separate version or fork of Linux. This was due to a disagreement about new features Google felt were necessary (some related to security of mobile applications). The code which is no longer maintained was deleted in January 2010 from the Linux codebase. Google announced in April 2010 that they will hire two employees to work with the Linux kernel community. However, as of January 2011, points of contention still exist between Google and the Linux kernel team: Google tried to push upstream some Android-specific power management code in 2009, which is still rejected today. Android (operating system) 12 Furthermore, Greg Kroch-Hartman, the current Linux kernel maintainer for the -stable branch, said in December 2010 that he was concerned that Google was no longer trying to get their code changes included in mainstream Linux. Some Google Android developers hinted that "the Android team was getting fed up with the process," because they were a small team and had more urgent work to do on Android.

VII. CLAIMED INFRINGEMENT OF COPYRIGHTS AND PATENTS

On 12 August 2010, Oracle, owner of Java since it acquired Sun Microsystems in April 2009, sued Google over claimed infringement of copyrights and patents. The lawsuit claims that, "In developing Android, Google knowingly, directly and repeatedly infringed Oracle's Java-related intellectual property. "Specifically the patent infringement claim references seven patents including United States Patent No. 5,966,702, entitled "Method and Apparatus for Pre-processing and Packaging Class Files," and United States Patent No.6, 910,205, entitled "Interpreting Functions Utilizing A Hybrid Of Virtual And Native Machine Instructions." It also references United States Patent No. RE38, 104, ("the '104 patent") entitled "Method and Apparatus for Resolving Data References in Generated Code" authored by James Gosling, best known as the father of the Java

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programming language. In response Google submitted multiple lines of defence, saying that Android did not infringe on Oracle's patents or copyright, that Oracle's patents were invalid, and several other defences. They said that Android is based on Apache Harmony, a clean room implementation of the Java class libraries, and an independently developed virtual machine called Dalvik. The Free Software Foundation has called this suit a "clear attack against someone's freedom to use, share, modify, and redistribute software." However, the FSF also criticized Google, saying that Google could have avoided the suit by building Android on top of Iced Tea, whose GPL license provides some protection against patents, instead of implementing it independently under the Apache License. The FSF wrote "It's sad to see that Google apparently shunned those protections in order to make proprietary software development easier on Android." and remarked that Google had not taken any clear position or action against software patents.

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