

CyanogenMod as an Aftermarket Firmware Replacement for Android

Ashok Patel

Department of Computer Engineering, K.J. Somaiya College of Engineering, Vidyavihar, Mumbai, Maharashtra, India

Abstract: Android has grown tremendously as an open source operating system for mobile handsets (smartphones) and continues to expand covering various other aspects of our digital lives such as Television, cars, wrist watches, and other smart home devices. CyanogenMod is an aftermarket firmware developed using the Android Open Source Project sources and distributed officially as well as unofficially to numerous smartphones worldwide. Its impact as an alternative to Google's stock Android user experience and intervention into the realm of already overcrowded industry, with an aim of 'taking Android away from Google' is worth studying.

Keywords: CyanogenMod, Cyanogen, Android, Open Source Operating System, ROM.

I. INTRODUCTION

Android's mobile operating system is based on a modified version of the Linux kernel. Android as an operating system boasts of two main features that have fuelled its growth over the years. The increasing interest from the industry arises from these two core aspects: its open source nature and its architectural model. Being an open source project, allows Android to be fully analysed and understood, which enables feature comprehension, bug fixing, further improvements regarding new functionalities and, finally, porting to new hardware. On the other hand, its Linux kernel-based architecture model also adds the use of Linux to the mobile industry, allowing taking advantage of the knowledge and features offered by Linux[1]. CyanogenMod is an alternative operating system (ROM) built on top of Android, meant for smartphones and various tablet machines that are capable of housing these aspects.

Owing to the plethora of user oriented features and constant support by a large base of developers worldwide, it has seen itself grow into a fully commercial entity over the years, today supporting over more than 50 million devices all over the world [2]. As of today, Cyanogen Inc. is an established commercial enterprise with headquarter offices in Seattle and Paulo Alto [3], and has no intentions of looking back.

II. HISTORY - THE INCEPTION

Android boasts of its open source nature, and right about in September 2008[4] when the first fully functional Android smartphone, the T-mobile G1 was introduced (also known as the HTC Dream), a method was devised to gain privileged system access (root access). This made the stock firmware offering available for modification and all kinds of changes in source code were facilitated. Taking advantage of this 'root' access, developer Jessfreke pushed a custom ROM with a slew of changes in the following year [5]. However, development on that release stopped and Dream owners were suggested to use a further modified version of the ROM then maintained by developer Cyanogen - Steve Kondik. It received an overwhelming

response worldwide, as it removed all barriers put in by carriers and resellers, and features that were otherwise charged for, were committed into release builds.

The ROM was thus named aptly CyanogenMod [3]. The developer base was limited back then to the 'Team Douche', the modders behind the ROM. In 2012, Kirt McMaster, Koushik Dutta and Steve Kondik came together to embark on a journey with the foundation of Cyanogen Inc supported by Venture Capitalists Benchmark and Redpoint Ventures with a funding of \$7 million[6]. With the aim of commercialising CyanogenMod, it was made official in April 2013, and has been growing ever since with the backing of numerous developers, modders, themers from all over the globe. Moreover, it caught the eyes of giants such as Microsoft, pitching in their services deeply integrated into the ROM with services such as Cortana, the digital personal assistant coming preinstalled with updates.

III. CONFLICTS AND RESOLUTIONS

The advent of Cyanogen Inc. created many ripples in the industry, for obvious reasons. It led to a certain degree of discord among the developers in the CyanogenMod community as they were of the opinion that their contribution towards the development of the ROM was not duly acknowledged, and that it should not have been commercialised without doing so. More so, it was undermining the original ethos of the project and conflicts with developers like Guillaume Lesniak (xplodwild)[6], who contributed towards the project concerning the licensing of the 'Focal' app further heated the issue. In response to which, Steve Kondik affirmed commitment to the CyanogenMod community and that Cyanogen Inc. is putting forward the proposal of dual licensing (GPL and Apache) in order to provide a "stronger degree of protection for contributors... while still offering CM some of the freedoms that the Apache license offers". This had never happened before, as stated by John McKenzie in his email to Steve on 20 August 2013 - "This is the first time that someone making a significant GPLv3 contribution was put under significant

pressure to change it to a dual license AFTER the work was completed”[7].

Cyanogen Inc. clearly distinguished between its two offerings CyanogenMod and Cyanogen OS, the latter being a commercially developed OS for specific devices, OEMs of which have signed a partnership with Cyanogen Inc. Those OEMs include One Plus, Yu, Andromax, Lenovo, Wileyfox and like. CyanogenMod on the other hand is the community developed firmware replacement meant for devices with Android pre-installed. However, Cyanogen Inc.’s partnership with One Plus saw a conflict after the former’s tie-up with Micromax Yu ventures to provide exclusive support to Yu series smartphones in India. One Plus later discontinued Cyanogen OS that came preinstalled in its flagship device One Plus One , and further went ahead to develop its own operating system - Oxygen OS[8].

Cyanogen Inc. also partnered with Microsoft to fulfil its vision of dissociating Android from Google, and making it truly open source. The underlying aim of the deal signed in April 2015 was to integrate and distribute Microsoft’s consumer apps and services across productivity, messaging, utilities and cloud-based services, with native integration in Cyanogen OS promising a ‘powerful new class of experiences for its users’ [9].

One such integration was that of Microsoft’s own voice-based personal mobile assistant Cortana into Cyanogen OS, to compete with its rivals including Google Now and Siri by Apple. Kirt McMaster said Cortana will help Cyanogen reach its goal of "no dependencies on Google" within the next few years, but the company will need some partners that consumers have actually heard of if it hopes to hit long-term success[8].

TABLE I: COMPARISON BETWEEN CYANOGEN OS AND CYANOGENMOD

Name	Stock replacement/firmware	Installation	Root access	Development Support	Updates
Cyanogen OS	Stock firmware pre-installed on some smartphones.	Pre-installed on some devices	NOT available	Cyanogen Inc.	Take longer, usually months
CyanogenMod	Replacement firmware for devices with Android pre-installed.	Manual installation (Using Custom recovery)	Available	Community developed	Faster, usually within days or weeks.

IV. DEVELOPMENT

The first hint of a custom ROM for an Android device under CyanogenMod was seen when developer Cyanogen (Steve Kondik) enhanced JessFreke’s firmware and released it for The T-Mobile G1 (also known as the HTC Dream) in July 2009. Ever since then, due to an overwhelming response by Android enthusiasts, more devices were continuously added and it became one of the most popular aftermarket firmware distributions.

While Cyanogen OS is limited to a handful of devices in market, CyanogenMod officially supports over 150 devices with continuous update rollouts. The reach of CyanogenMod isn’t limited to these officially supported devices, but many more that get unofficial CM builds thanks to the large developer community that backs continuous development. The community releases official updates split into four categories - Stable, RC (Release Candidate), M-series and Nightlies. Stable versions are tried and tested variants of the firmware. They are superficially bug free and daily drivers for end users, with minimum number of flaws that are insignificant to affect functionalities in general. RC versions are those that are close to Stable without major flaws or any major bugs. The M-series builds are ‘a bit more stable’ and released for supported devices at the beginning of every month[10]. And lastly, the Nightlies are released every day or two, and are tagged to be untested thoroughly, thus containing experimental features that may break the device[11]. This tagging system was followed up to the release of CM 10.2. However, the community builds from CM 11 to CM 13 have reduced the number of build tags to just two: Nightly and M Snapshots. The tag names have been retained for historical reasons, but this is just a basic two channel release system[12].

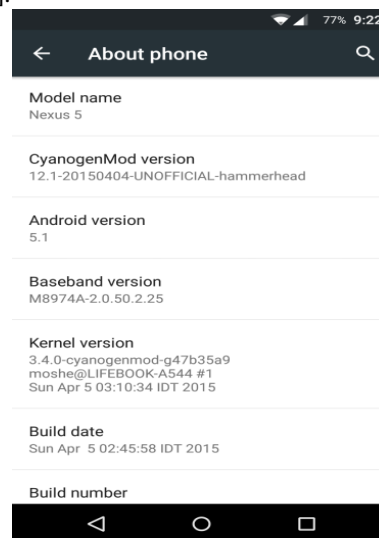


Fig. 1 Snapshot of CyanogenMod ROM running on hammerhead (LG Nexus 5)

A brief history of build releases by CyanogenMod community for all of the officially supported devices can be seen in table 2[13].

TABLE 2 : RELEASE HISTORY - VERSIONS OF CYANOGENMOD

CyanogenMod version	Based on (Android version)	Last/Latest Build Number	Release date
3	Android 1.5 (Cupcake)	3.9.3	22 July 2009
4	Android 1.5/1.6 (Cupcake/Donut)	4.2.15.1	24 October 2009
5	Android 2.0 (Eclair)	5.0.8	19 July 2010
6	Android 2.2 (Froyo)	6.1.3	6 December 2010
7	Android 2.3 (Gingerbread)	7.2.0	16 June 2012

9	Android 4.0 (Ice Cream Sandwich)	9.1	29 August 2012
10	Android 4.1/4.2/4.3 (Jelly Bean)	10.2.1	31 January 2014
11	Android 4.4 (KitKat)	11.0 (XNG3C)	31 August 2015
12	Android 5.0/5.1 (Lollipop)	12.1 (YOG7D)	17 November 2015
13	Android 6.0 (Marshmallow)	13.0	18 January 2016 (Nightly)

CyanogenMod 8 was never released as Google did not release the source code for Android 3.0 Honeycomb (meant only for tablet devices).

V. FEATURES

The popularity of CyanogenMod over the years can be attributed to the features that it provides over stock Android OS. The core idea behind every release is ensuring that the release is/remains -

- Secure
- Light footprint
- Bloat-free
- Customisable
- Open

Following are the features of every CM ROM that ensure the same:

- **CM Updater** - CyanogenMod's own implementation for OTA updates, with scheduling.
- **Privacy Guard** - Manage permissions on a per-app basis, controlling what application has access to the device hardware and other features.
- **Global Blacklist** - Ability to flag unwanted and unknown phone calls (Discontinued)
- **Quick Settings Customisation** - Ability to customise the positioning and functionality of each Quick Settings tile (CM 9 and above)
- **Theme Engine** - Allows third party themes developed for the Theme Engine to be installed, can change almost every visual aspect of the ROM
- **Trebuchet Launcher** - CyanogenMod's default home launcher providing extra customisation over stock Android Launcher
- **Status Bar Behaviour** - Control over Status Bar icons and its behaviour
- **CM Account** - A secure, encrypted and optional personal account service by CyanogenMod
- **CM File Manager** - An application pre-installed to organise and manage files in internal as well as external device storage.
- **Profiles** - Change device connectivity behaviour adapting to the environment in which the phone is being used.
- **Root access (Superuser)** - Manage root access given to individual applications, debugging tools, and maintain logs.
- **Performance** - Ability to access power tools to set CPU clock frequencies, kernel behaviour and set device governors[14].

On the other hand, Cyanogen OS has a different set of features that separate it from stock Android experience, including tie-ups with major services offered by Microsoft, TrueCaller and partnerships with brands such as OPPO, One Plus, Yu, Lenovo, Qualcomm etc to bring a refined experience to its users. Although ensuring the implementation of the core ideas of security and customisation, it doesn't provide as much control over the device as CyanogenMod, mainly because of the fact that the end user of Cyanogen OS is not concerned with full control, unless the device is intended for development purposes.

VI. FUTURE

CyanogenMod has come a long way as an aftermarket firmware offering extra functionality and control over a device, and helping lengthen the 'life' of an Android smartphone by providing official as well as unofficial updates to newer and most of the times, latest Android versions which otherwise may not be made available. Cyanogen Inc., the company founded to help support and expand CyanogenMod, and its partnership with a slew of OEM's and brands will help them spread the reach of Cyanogen OS and more and more number of upcoming devices will have Cyanogen OS pre-installed. Thus, CyanogenMod and Cyanogen Inc. both will continue to grow parallel, supported as long as Android itself exists.

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