



Can Android be Open Source and functional?

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What are we talking about?

We will look at:

- Drilling down: 6 layers of an Android mobile device
- Picking your battles: Open Source options for each layer
- Practical application: Terms and tools for installing an Android OS
- Hard lessons learned: Experiences with an Open Source smartphone
- Tips and tricks: Staying open inside the Google ecosystem
- Goodbye Google: Rolling your own cloud synchronization



Why I Decided to Rebuild my Smartphone

- Carriers are reducing a user's ability to manage their own device
- Carriers are installing non-removable bloat-ware and tracking apps
- Carriers are limiting support/upgrades for older device models
- Commercial apps are often opaque with collection and sale of data
- If I promote Free & Open Source technologies, ethically shouldn't I be using Open Source devices as much as I can?
- Can a smartphone be productive if limited to only Open Source?

Layers of an Android Device

Layers of an Android Device

1: Physical Hardware



Layer 1: Physical Hardware

Proprietary Hardware Options

- Majority of smartphones, tablets, and other mobile devices on the market
- Manufacturers include: Acer, Asus, HTC, Huawei, LG, Motorola, Samsung, Sony Ericsson, ZTE



Samsung Galaxy S3 I9300,
GSM Arena

Open Hardware Options

- A few kickstarter/Indiegogo “pipe-dream” devices, inc. Root101, Neo900
- Golden Delicious GTA04 board (from Europe: 529euros / \$580)
- Raspberry Pi home-brew phone



GTA04 board in Openmoko
Neo freerunner case

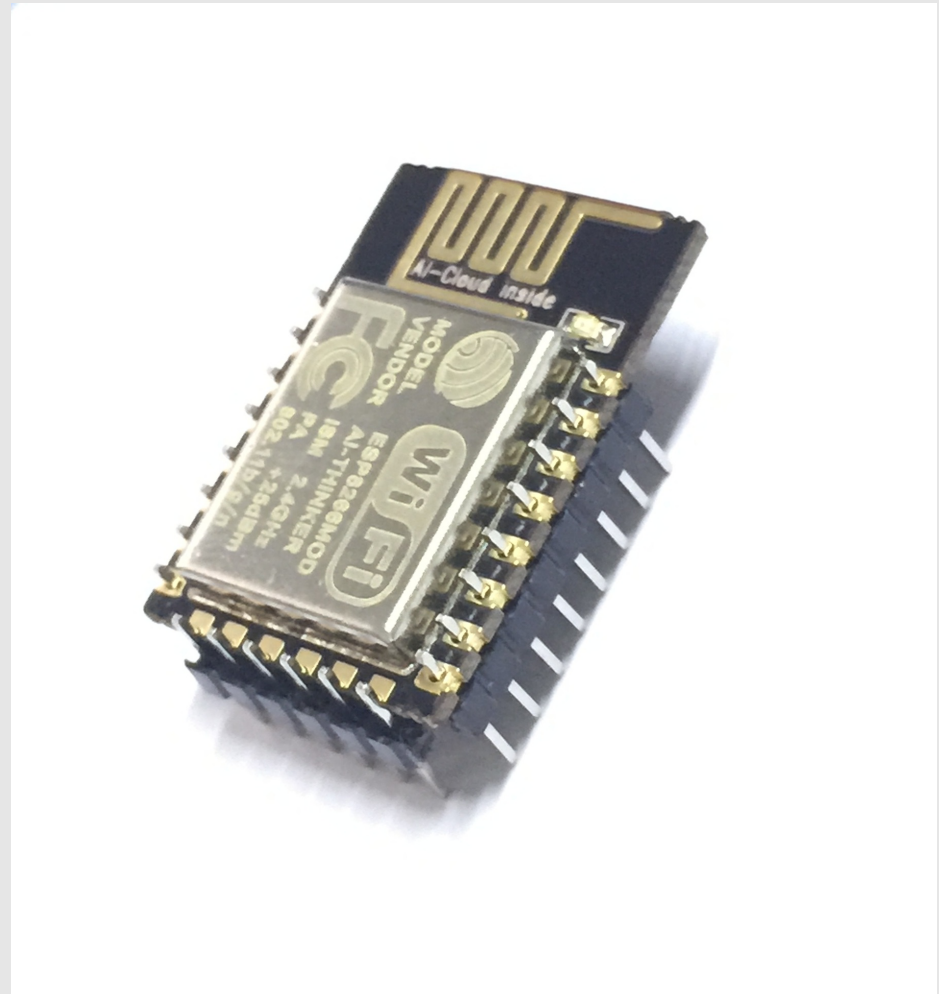
Layers of an Android Device

1: Physical Hardware

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2: Hardware Drivers

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Layer 2: Hardware Drivers

Proprietary Driver Options

- Most manufacturers release hardware module drivers as binary blobs under closed source licensing
- Module drivers (firmware) added on top of Linux OS
- Similar to the historical M\$ Windows ecosystem

Open Source Options

- Open source drivers/firmware may be available but it depends on the module chipset
- Older devices from certain manufacturers have some open source firmware
- To run a fully working device, we have to mix-n-match open and proprietary firmware

Layers of an Android Device

1: Physical Hardware

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2: Hardware Drivers

— — — — —

3: Operating System

— — — — —



Layer 3: Operating System

Android OS using proprietary firmware and apps

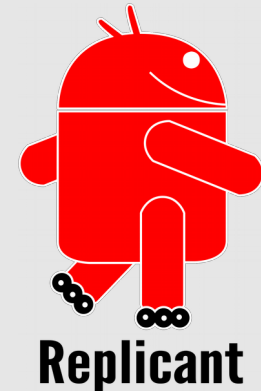
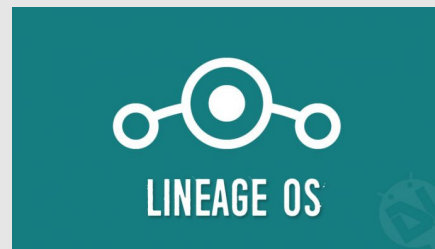
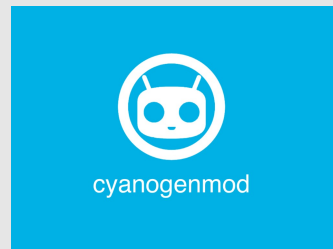
- “Stock” Google Android
- Carrier built Android

Android OS using only Open Source firmware and apps

- Replicant OS
 - Security/privacy focused
- Omni-The Open ROM



- Cyanogenmod → Lineage OS
 - User customization focused



Layers of an Android Device

1: Physical Hardware

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2: Hardware Drivers

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3: Operating System

— — — — —

4: App Repository

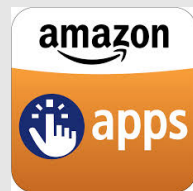
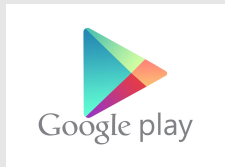
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Layer 4: App Repository (Marketplace)

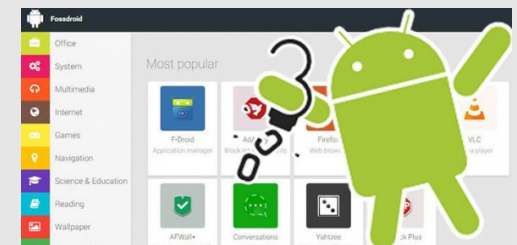
Proprietary Repo Options

- Google Play
 - The core of Google apps
 - Part of “stock” Android
- Third party commercial repos
 - Amazon Appstore
 - Aptoide
 - AppBrain



Open Source Repo Options

- Free and Open Source (FOSS) only Android app repositories
 - F-Droid
 - Fossdroid



Layers of an Android Device

1: Physical Hardware

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2: Hardware Drivers

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3: Operating System

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4: App Repository

— — — — —

5: User Apps

— — — — —



Layer 5: User Apps

Proprietary App Options

- Google Mobile Services (GMS)
 - Often known as GApps
- Most popular apps and games available on commercial repos
 - Examples inc. Angry Birds, Facebook Messenger, FitBit, Uber, Whatsapp
- EULAs = “Signing over your private data to highest bidder”



Open Source App Options

- Base apps on vanilla Android
 - Browser, Calendar, Phone
- FOSS apps on F-Droid/fossdroid
 - Examples inc. Blockinger, ConnectBot, Face Slim, K-9 mail, QKSMS, Xabber
- Apps in development on GitHub
 - Harder to find/install and may not fully work



Layers of an Android Device

1: Physical Hardware

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5: User Apps

— — — — —

6: Cloud Storage & Sync



Layer 6: Cloud Storage & Synchronization

Proprietary Cloud Options

- Google Ecosystem
 - Calendar, Contacts, Drive, Email, Hangouts, Voice
- Facebook Messenger
- Microsoft Outlook/Exchange
- Any Others?



Open Source Cloud Options

- POP/IMAP mail server
 - Postfix, Dovecot
- Calendar and contact sync
 - Radicale, Bedework, DCS
- IRC/XMPP chat server
 - UnrealIRCd, ejabberd, wire
- Fully featured private cloud
 - Owncloud / Nextcloud, Seafile, git-annex



Terms and Tools used by “modders”

Terms used on the forums

- ‘Rooting (Jailbreaking)’
 - gaining root access
- ‘Unlocked’
 - Use on any cellular carrier
- ‘Custom ROM’
 - Android OS image file
- ‘Flashing’
 - low-level copying of custom ROM onto phone
- ‘Porting’
 - Building a custom ROM for device from source code

Tools to flash Android ROMs

- Android Debug Bridge (ADB)
 - Remote command-line/shell via USB connection
- Heimdall
 - Remote flashing of ROM to phone via USB connection
- ClockworkMod (CWM) and Team Win (TWRP)
 - Recovery ROMs with copying/debugging options
- Recovery and boot partitions are flashed separately

6 Months: Lessons Learned

- Ask your carrier to switch to phone after you are ready to switch!
- Replicant OS is not for the faint of heart
 - Purchase the exact device model for the custom ROM
 - Samsung Galaxy S3 alone has GT-I9300, GT-I9305, SGH-T999, SGH-I747, SCH-R530, SCH-I535, and SPH-L710
 - Replicant OS only works with the GT-I9300 (intl) model!
 - Unless proprietary firmware is installed by user via ADB, some hardware modules will not work
 - Current build runs Android 4.2. Replicant 6.0 in development
- Lineage OS is a good “intermediate” level custom ROM
 - All hardware modules work as part of ROM, but are not FOSS
 - Custom ROMS for many mobile devices
 - Current build (14.1) runs Android 7.1.1 Nougat

Open Source within Google Ecosystem

- FOSS webDAV apps have limited access into Google cloud services
- Google uses CardDAV (contacts) & CalDAV (calendar) protocols
 - DAVdroid can access CardDAV with following URL:
 - <https://apidata.googleusercontent.com/caldav/v2/calid/user>
 - where calid is gmail address, i.e.
 - <https://apidata.googleusercontent.com/caldav/v2/ben%40gmail.com/user>
 - Caldav Sync Adapter can access CalDAV with following URL:
 - <https://www.google.com/calendar/dav/calid/events>
 - where calid is gmail address or shared calendar ID, i.e.
 - <https://www.google.com/calendar/dav/ben%40gmail.com/events>
 - Further information can be found at
 - <https://developers.google.com/google-apps/calendar/caldav/v2/guide>

Accessing Other Google Services

- GApps Browser can access Google cloud services inside a sandbox
- IMAP can be turned on in Gmail settings for FOSS email clients
- Google Voice calls and texts can be forwarded to a cellular phone
 - Reply to unique Google # using standard SMS text messages
- If you cannot live without Google Mobile Services (GMS/Gapps)
 - Open GApps project offer add-on ROMs for the GMS set of proprietary Google apps

Goodbye Google: Roll your own cloud

- Run a private Calendar and Contacts server?
 - Radicale
 - Simple CalDAV/CardDAV private hosting and management service
- Or an entire private cloud on your private server?
 - Owncloud / Nextcloud
 - WebDAV secure file and photo storage, CalDAV calendar and CardDAV contacts management, Ampache streaming media, and video conferencing
- IRC chat client to talk on Facebook Messenger or Google Hangouts?
 - BitlBee: running on IRC server of your choice, i.e. UnrealIRCd
 - IRC to chat networks gateway, inc. MQTT (Facebook Messenger), Google Hangouts, Twitter, Torchat, and XMPP (jabber/slack)

In conclusion...

- Can you run a completely Open Source Android device?
 - Hard, but not impossible
 - Replicant OS can be used with limited functionality
- Can you run an Android device with all Open Source apps?
 - Yes!
 - Lineage OS gives full functionality of a device
 - F-Droid and Fossdroid are Open Source only app repos
- Can you run a fully synchronized device without Google?
 - Yes!
 - Roll your own CardDAV/CalDAV server using Radicale or NextCloud
 - Remember to secure your server using Let's Encrypt SSL certs!

Thank You!

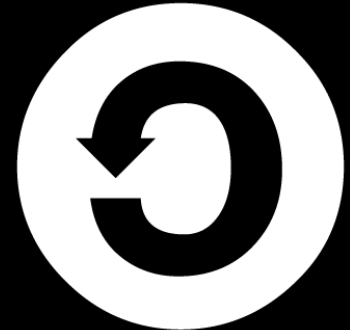
Ben Roose: ben.roose@wichita.edu

These slides can be found at:
<https://github.com/benroose/presentations>

Any Questions?



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