Embedded AOSP

Intro. AOSP.

09-13 July

Polytechnic University of Bucharest

Partnered with Google

AOSPi Summer School

- Android Open-Source Project + Raspberry Pi 😻
- The Plan:
  - Day 1: install it!
  - Day 2: build an app (userspace architecture)
  - Day 3-4: Hardware-Android interface
    - Bring RPi GPIOs to apps!
  - Day 5: Android Automotive, maybe?
- Time Schedule:
  - Wed - Friday: 16:00 - 22:00
  - Sat - Sun: 10:00 - 16:00 ?

Android History

- 2003: Started as a startup called Android Inc. in Palo Alto/CA, focused on developing an open operating system for smartphones
- 2005: Android Inc. acquired by Google
- 2007: Created the Open Handset Alliance, a consortium of companies interested in the mobile devices area (Google, Intel, TI, Qualcomm, Nvidia, Motorola, HTC, Samsung, etc.)
- 2008: Android version 1.0 is released (HTC Dream)
- … 2024 -> Android 16 (iOS 18 :D)

Features & popularity

- The operating system base (AOSP) is open source
- Graphical interface with a very familiar experience.
- Vast application ecosystem (~1.5M applications in 2025). https://www.appbrain.com/stats/number-of-android-apps
- Complete framework for application development, with APIs, IDE (Android Studio), emulator, debugging and testing tools, documentation, books, videos, etc.
- Initially based on Java, now Kotlin / Flutter+Dart etc.

Android in Embedded / IoT

- AOSP has a solid architecture making vendor customizations easy!
- The Android operating system has surpassed the barrier of mobile devices and is currently used in different embedded system solutions:
  - Vehicle multimedia entertainment centers
  - Cable TV equipment, Smart TVs
  - Credit card machines
  - Self-service terminals
  - Smart watches
  - Household appliances (refrigerators, washing machines etc.).

Android Open-Source

- Android is basically based on several major projects:
  - Linux Kernel (+ patches)
  - Android Platform (AOSP)
  - Vendor components
- With each release, Google releases the project's source code through the Android Open Source Project (AOSP): https://source.android.com/
- Only a few devices are natively supported by AOSP, including the latest Google devices (Pixel), emulators and some reference boards (DragonBoard 845c, Qualcomm Robotics Board, Khadas VIM, etc). https://source.android.com/docs/setup/create/devices

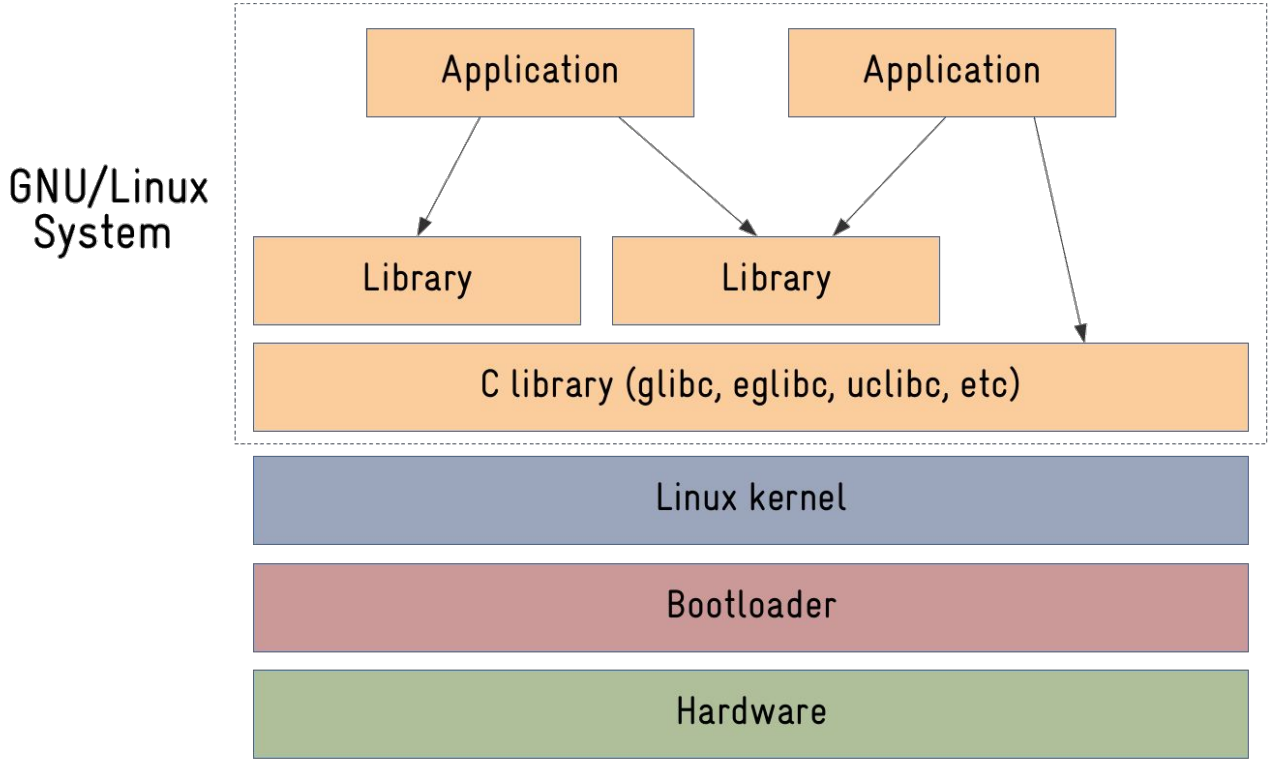
Android Version Management

- AOSP is versioned by Google through Git
- However, the project is divided into hundreds of Git repositories
  - Total source code size is ~100GB !!
- If the project were managed by just one Git repository it would be slow to download and difficult to manage!
- ***repo***: one tool to manage them all
  - `repo sync`, `repo push`, `repo diff`, `repo forall` ...
- The Android Git repositories can be accessed at the link below: https://android.googlesource.com/

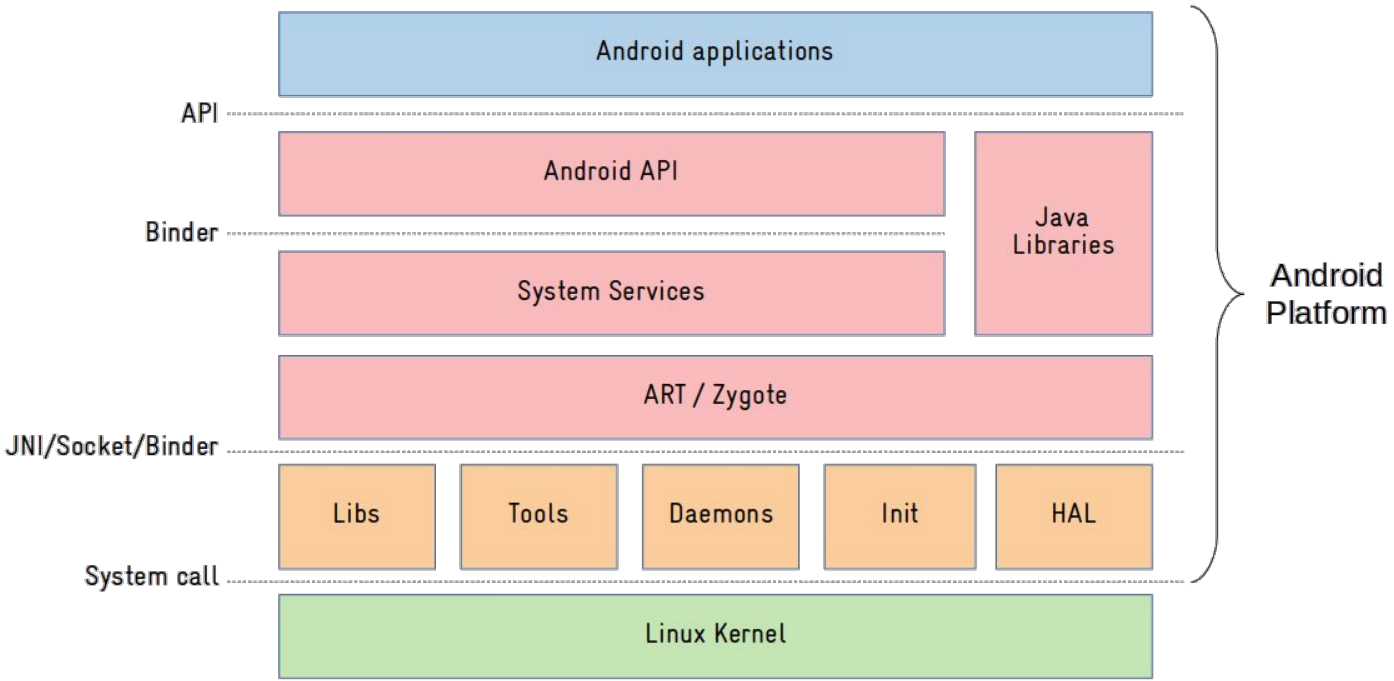
Building Linux Distributions

- Build systems have the main purpose of integrating all the software components of a Linux system (toolchain, bootloader, kernel, libraries and applications) and building the operating system image
- In Linux, the two main build system projects are:
  - Buildroot
  - Yocto Project / OpenEmbedded
- However, Android has its own build system!
  - Initially: makefiles (*.mk files still remain in source code*)
  - Android 7+: Soong (convert Blueprints + Makefiles to Ninja)
- Android 13+ requires 64GB RAM + 300GB free space for a [minimal] build!

GNU/Linux Architecture



Android System Architecture



https://sergioprado.blog/what-differs-android-from-other-linux-based-systems/

Resources

- https://source.android.com/
- Raspberry Vanilla: https://github.com/raspberry-vanilla/
- Labs: https://github.com/cs-pub-ro/AOSP-RPI-docs

Enough theory!