Android OS

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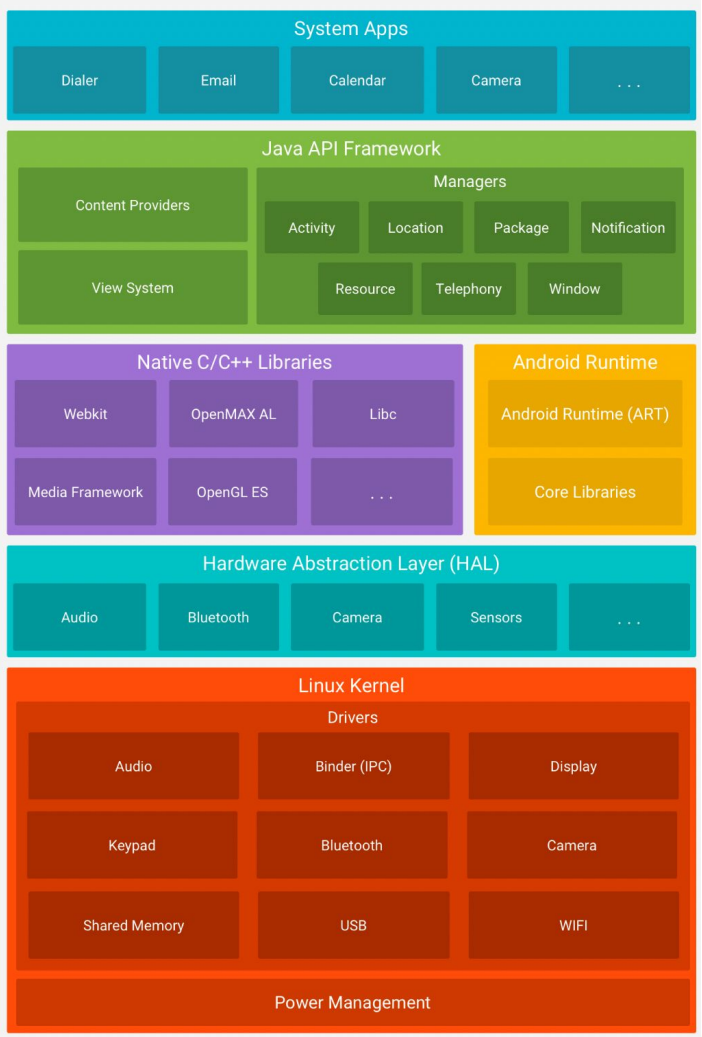
General History

- Founded in 2003, palo alto
- originally meant to improve the operating systems of digital cameras
- Bought by Google in 2005, released as the android open source project in 2007.
- Emphasis has always been on enhancing infrastructure based on limited resources available on mobile devices.
- Each major update was named after a dessert until android 10.
- Current version is Android 12.

Architecture

- Six layers
  - System Apps
  - Java APIs Framework
  - Libraries
  - Android Runtime
  - Hardware Abstraction Layer
  - Linux Kernel



Linux Kernel

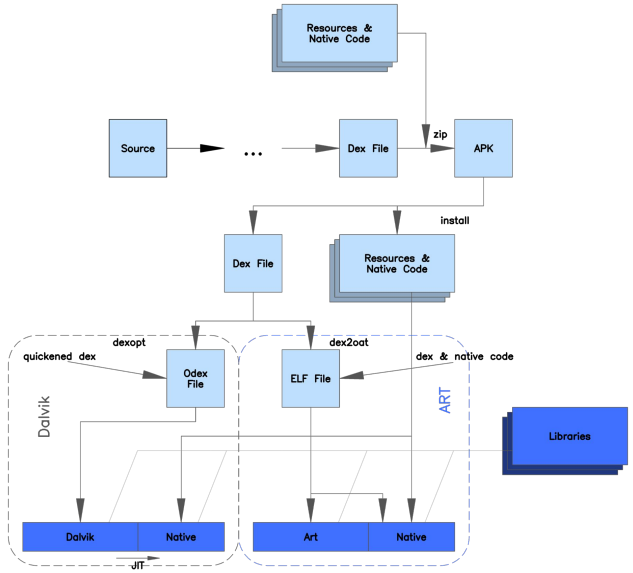
- Chosen because it’s good at networking, with a vast array of device drivers to take out the pain of interfacing to peripheral hardware.
- Possible to offer os to third-party mobile manufacturers for free.
- manages core functionality.
- Allows Android to take advantage of security features.

Hardware Abstraction Layer

- Provides standard interfaces that expose device hardware capabilities to higher level Java API Framework
- Multiple library modules, each of which implements an interface for a specific type of hardware component.

Android Runtime

- Each app runs in its own process and with its own instance of Android Runtime (ART)
  - DEX files
  - Build tools
- Major Features
  - Ahead–of-time and just-in-time compilation
  - optimized garbage collection
  - optimization of DEX files
  - Better debugging



Libraries

- Written in C/C++
- exposes functionality of native libraries to apps

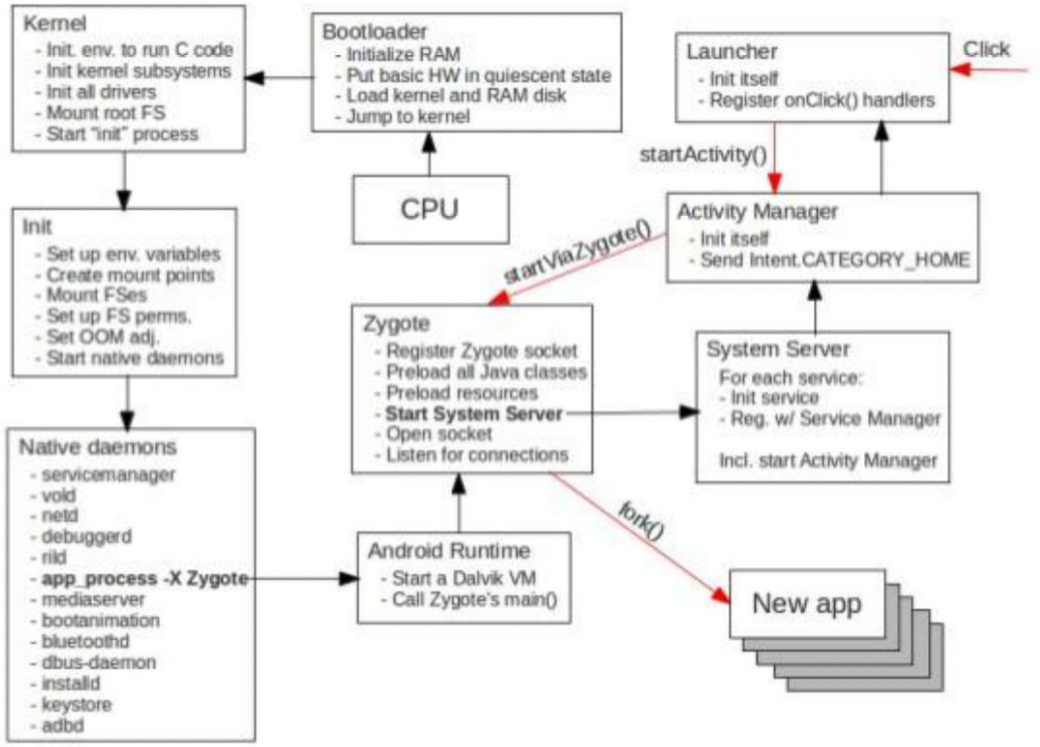
Java API Framework

- Entire feature-set is available through APIs written in Java
- modular system components
  - View system
  - Resource manager
  - Notification manager
  - Activity Manager
  - Content provider

System Apps

- Site of all android applications
- Comes with a set of core apps for email, SMS, calendars, internet browsing, contacts, and more.
- Included apps have no special status.

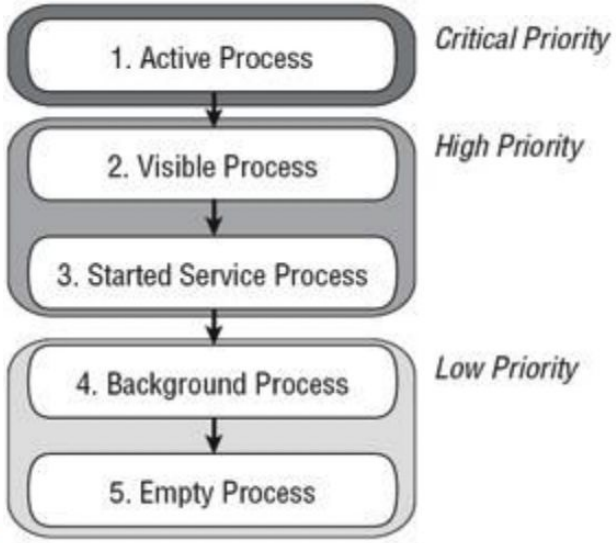
Kernel and Startup



android

CPU Scheduling

- Based on Linux Kernel 2.6
- O(1) scheduling algorithm, completely fair scheduler
- Process has “nice” levels which impacts scheduling policy, and make use of Cgroups



Memory Management

- Paging and memory-mapping
- ART keeps track of each memory allocation and garbage collects
- Shares RAM pages across processes
  - forked from existing zygote
  - static data mapped into a process
  - shares dynamic ram across processes with ashmem or gralloc
- Dalvik heap constrained to a single virtual memory range
- Restrict app memory
- Caches apps for switching.

Resources

- https://developer.android.com/guide/platform
- https://arxiv.org/pdf/2104.09487.pdf
- https://www.researchgate.net/publication/326507076_Android_Operating_System_Architecture
- https://www.researchgate.net/publication/319617606_Evolution_of_Android_Operating_System_A_Review
- https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3946637
- https://ieeexplore.ieee.org/document/6182081