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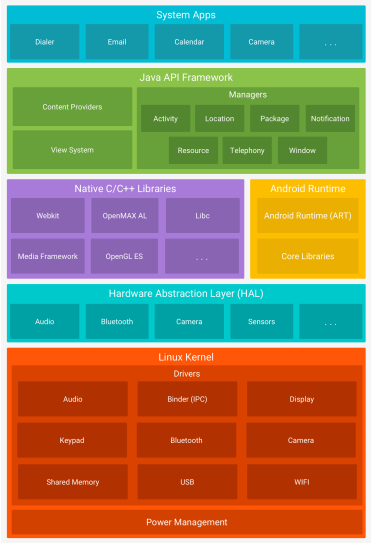
1 Architecture

- A software stack for mobile devices
- Operating system kernel
- Standard middleware
  - Android library support
- Key applications / user interfaces
  - Vendor specific modifications
- LK: threading, low level memory management, driver
- HAL: libs for hardware module
- AR: virtual machine
- NCL: fundamental core functionalities
- API: programming interface
- APP: system apps can be customised.



1.1 Kernel

1.1.1 Modifications

Modifications made by android to linux OS

- wakelocks
  - Keep the phone awake
- binder
  - Interprocess communication mechanism, and remote method invocation system.
  - One Android process can call a routine in another Android process
- ashmem
  - Android Shared Memory
  - A component of the Android operating system that facilitates memory sharing and conservation
- oom kills processes when memory is low
- alarm manager
  - Wakes up the phone when necessary

1.2 Hardware support

- Bluetooth - BlueZ
- GPS Manufacturer provided libgps
- Wifi `wpa-supplicant`
- Display Standard framebuffer driver
- Keyboard Standard input event
- Lights Manufacturer provided liblights.so
- Audio Manufacturer provided libaudio.so
- Camera Manufacturer provided libcamera.so
- Power Management wakelocks kernel patch
- Sensors Manufacturer provided libsensors.so
- Radio Manufacturer provided libril.so

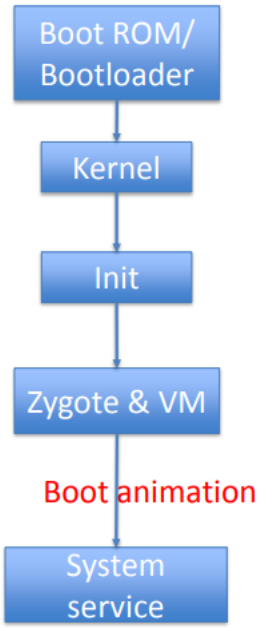
1.3 Security

Applications are sandboxed

- A security mechanism for separating running applications and data
- This allows applications run in a different context, so if one app crashed, others can stay uneffected
- On Android, each app runs as its own **user**, which guarantees that different users are unable to interfere with each other, access each others files and so on. Root can access the entire system
- Own process, own VM, own UID/AID for different app

2 System boot process

- **Boot ROM/ Bootloader:** Load bootloader into RAM, detect external RAM, setup network, memory, etc.
- **Kernel:** Setup cache, protected memory, scheduling and loads drivers.
- **Init:** Mounts directories like /sys , /dev or /proc Runs init.rc script
- **Zygote & VM:** Enables code sharing across the android VM for quick start of separate VM for different apps preloadClasses(), preloadResources()
- **System service:** Power manager, activity manager, telephony registry, package manger, context manager, system contact providers, etc.



3 Zygote

- Initialised process that has all core libraries linked in
- Load all java.*, android.* classes at boot time
- Initially create a single android VM process Referencing classes loaded above
- When user runs an application:
  - Creates a copy of itself in a separate address space
  - **Does not** copy memory, instead refers to original memory until modified
  - Because each container recieves a map, these resources are shared between applications, eliminating the need for each new fork of the VM to keep its own copy of classes and resource.

4 Memory

In many places, Android shares the same dynamic RAM across processes using explicitly allocated shared memory regions. Android uses paging and mmap instead of providing swap space, which means any memory your application touches cannot be paged out unless you release all references.

5 Android compilation

placeholder