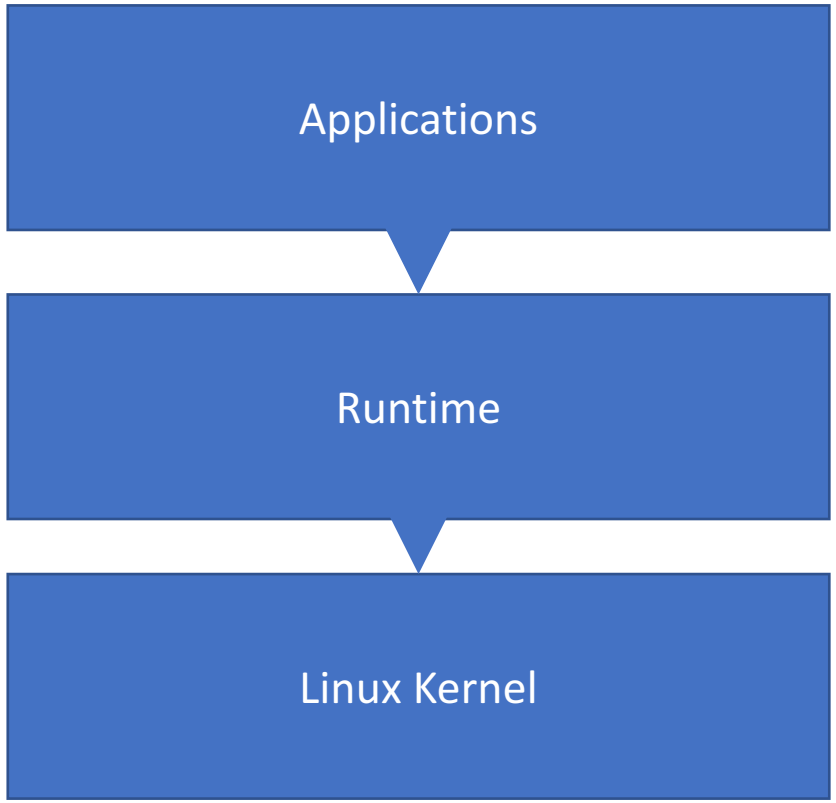
Android

Background

- Completely open source
  - What does this mean for consumption?
- Mobile Focused
  - What constraints does this add?
- Based on Linux kernel

How it stacks up



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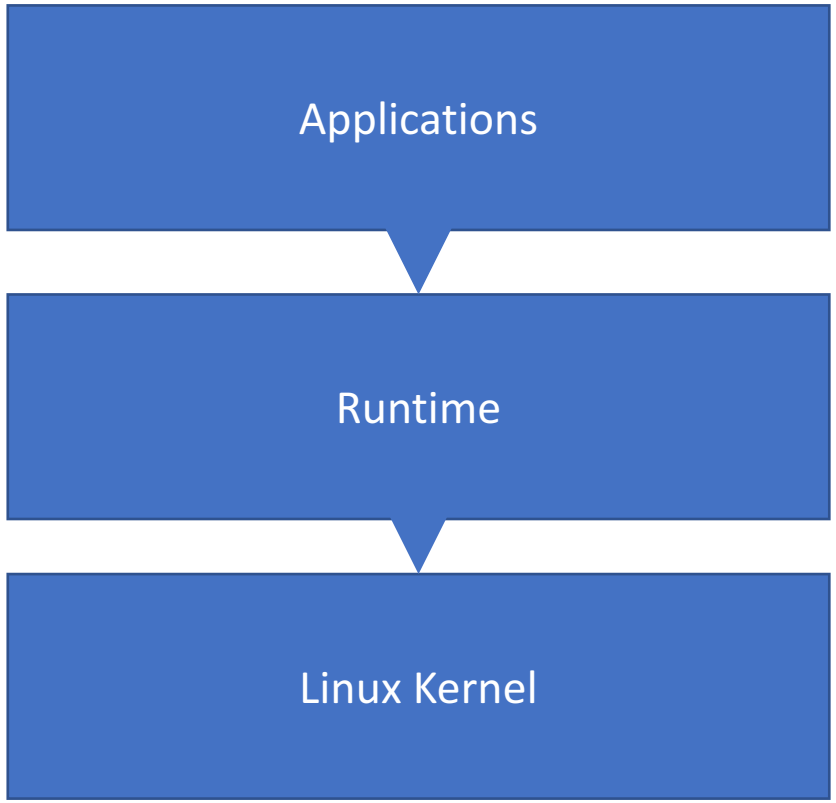

Custom stripped down version of Linux 2.6 (2003)
Re-use for existing drivers (wifi, display, … etc)
NO GAURENTEE THINGS THAT WORK ON LINUX WORK ON ANDROID

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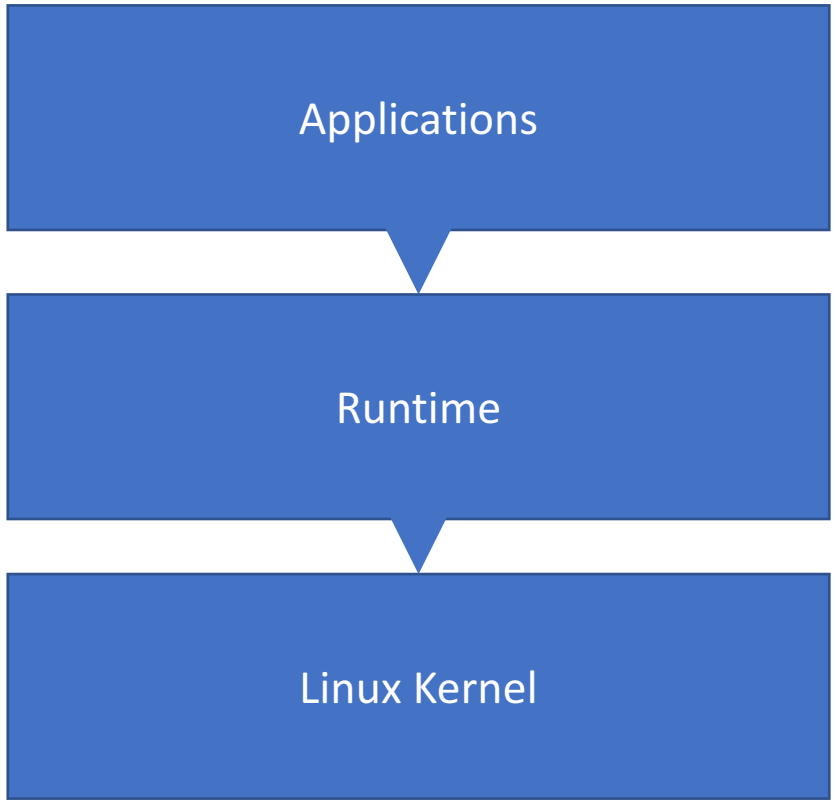

ART/Dalvik Virtual Machines
libc (Bionc and not posix)

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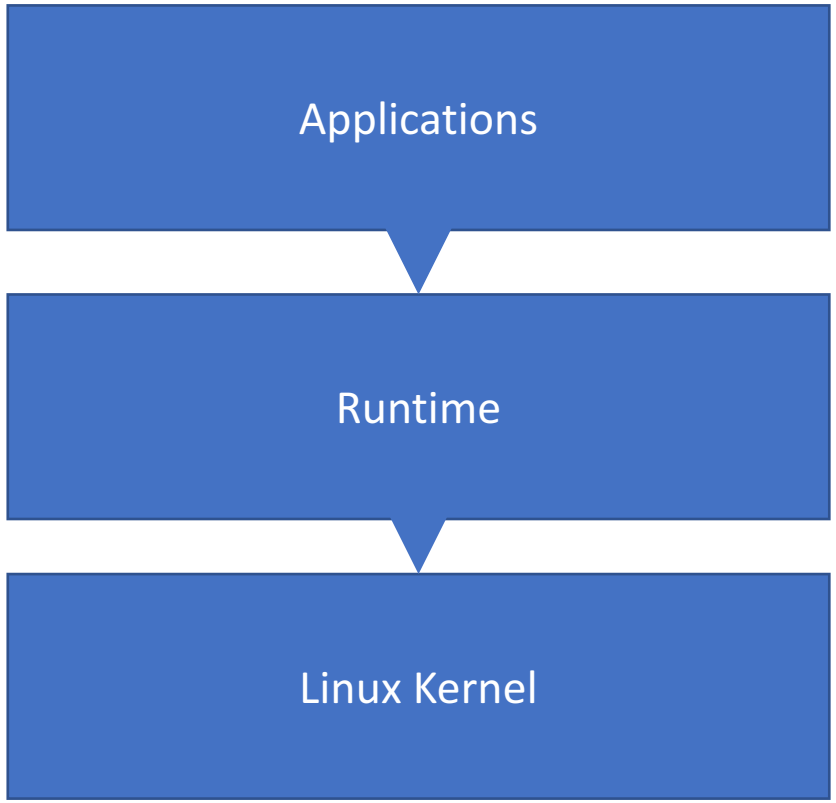

Apps written in C or Java (Google java, not oracle's)

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How it stacks up (Google's complete version)

Memory Model

- Constraint: Low memory, low battery, low/slow storage
- Issue: What do we do when we run out of physical memory?
- What happens with our current knowledge?

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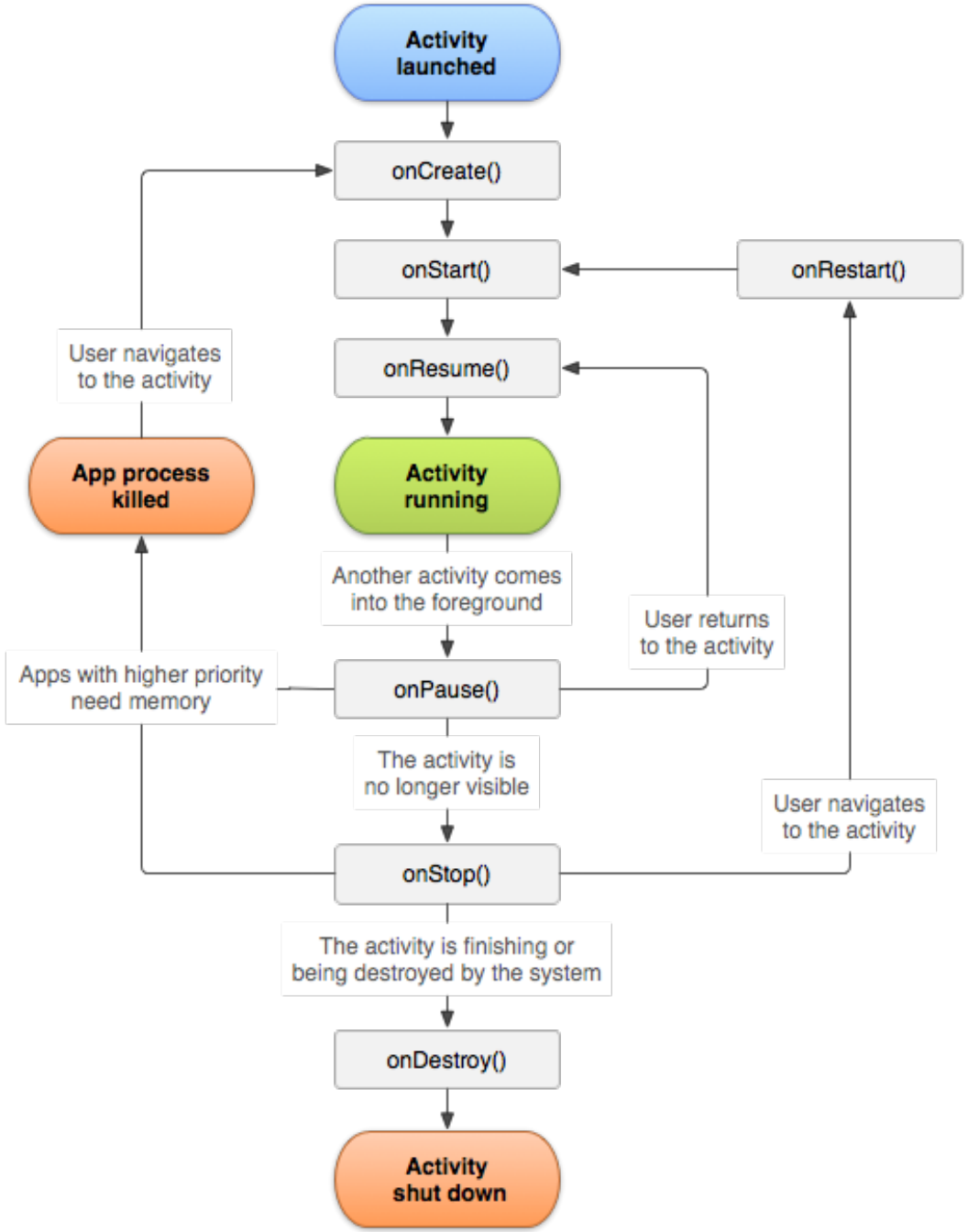
  - Issue for Mobile?
- Android App Life-cycle model

Memory Model

- Take advantage of only one app open on screen
- When users need more resources, kill an old app
- Give programmers a signal to tell them they are going to die to manually save any state
- Restart Process when brought back to foreground



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- Solution: So many things…

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- Motivation: Application isolation – never allow a different app to read my app's data
- Solution: So many things…
- App ownership: Each process is it's own user, all app's children of "Zygote" process
- Hardware/Memory Protection: All access coordinated through OS and runtime. Everything is sandboxed so the OS chooses what it is allowed to share
- Permissions: User must consent

From code to processor

Standard Linux Executable

- C code
- Compile to machine specific instructions
- Fork new process
- Load instructions into new process
- Add process to scheduler
- Running

Android – Off device

- Applications Written In Java using standard SDK, or C/C++ using NDK
- Compiled using gradle (or other) tools. Creates .apk file
  - This is basically a .class file for java
  - Runs compiler optimizations and condenses a bunch of .dex files together
  - .dex is an architecture independent file
  - Example:
    - dump
    - getNativeStuff() is example of NDK method

Android – On device

- Two different runtimes to interpret .apk files ART & Dalvik

- Dalvik is the legacy system
  - Slow!! Interprets virtually all instructions just like java would (Just In Time JIT compiler)
  - Froyo tried to solve this issue by constantly profiling and saving the compilation of common code paths
- Android Runtime introduced first in KitKat, Exclusive runtime in Lolipop
  - Ahead of time compilation: Slower to install apps, requires more storage

Android – On Device

Dalvik

- Decompose .apk into .dex files
- “Zygote” starts App

ART

- Decompose .apk into .dex files
- Compile .dex files to .oat files
  - Sample dump
- “Zygote” starts App

Sidebar: Zygote

- One of the first Processes started on the device
  - Definition of Zygote: “It is the initial cell formed when a new organism is produced”
- Creates app processes
- Handles all the heavy lifting of mapping memory
  - Sets up what is loaded where, and what pieces of physical memory can be shared between all apps… etc

Android – On Device

Dalvik

- Decompose .apk into .dex files
- “Zygote” starts App
- In the scheduler, .dex instruction loaded
- Instruction translated to machine code
- Run code

ART

- Decompose .apk into .dex files
- Compile .dex files to .oat files
  - Sample dump
- “Zygote” starts App
- In the scheduler, .oat instruction loaded
- Run code

Android – On device

- Check out /proc/[pid]/ folder! A lot of cool things