WEEK-2
Mobile Operating System: ANDROID OS
(Resources limitation and Management plan)

Dr Osei Eric Opoku

1. Operating System Resources

Mobile Operating Systems: Android

Try this on your phone:

##4636#*#*

Outline

- Historical Development
- Mobile OS in market
- Android OS
  - Introduction
  - Architecture
  - Application Development
  - Filesystem
  - Boot process
- Hardware
- Focus on

Historical Development

- 1973 – First mobile phone device by Motorola
- 1978 – Advanced Mobile Phone System (1G)
- 1990 – GMS standard (2G)
- 1993 – First smartphone by IBM with touch screen
- 1996 – Windows CE Handheld device
- 1998 – Psion Company develops Symbian
- 1999 – First Nokia phone with Symbian S40 (7110)
- 2002 – First smartphone by BlackBerry
- 2002 – 3G telecommunication technology
- 2007 – Apple iPhone with iOS introduced
- 2008 – Android 1.0 with the HTC Dream
- 2010 – Microsoft launches Windows Phone OS
- 2011 – MeeGo first Linux mobile by Nokia, Intel and Linux Foundation

Mobile OS in the market

- Manufacturer-built proprietary OS
  - Apple iOS, BlackBerry RIM, HP webOS
- Third party proprietary OS
  - Microsoft Windows Phone 7
- Open source OS
  - Android
  - MeeGo
  - Symbian

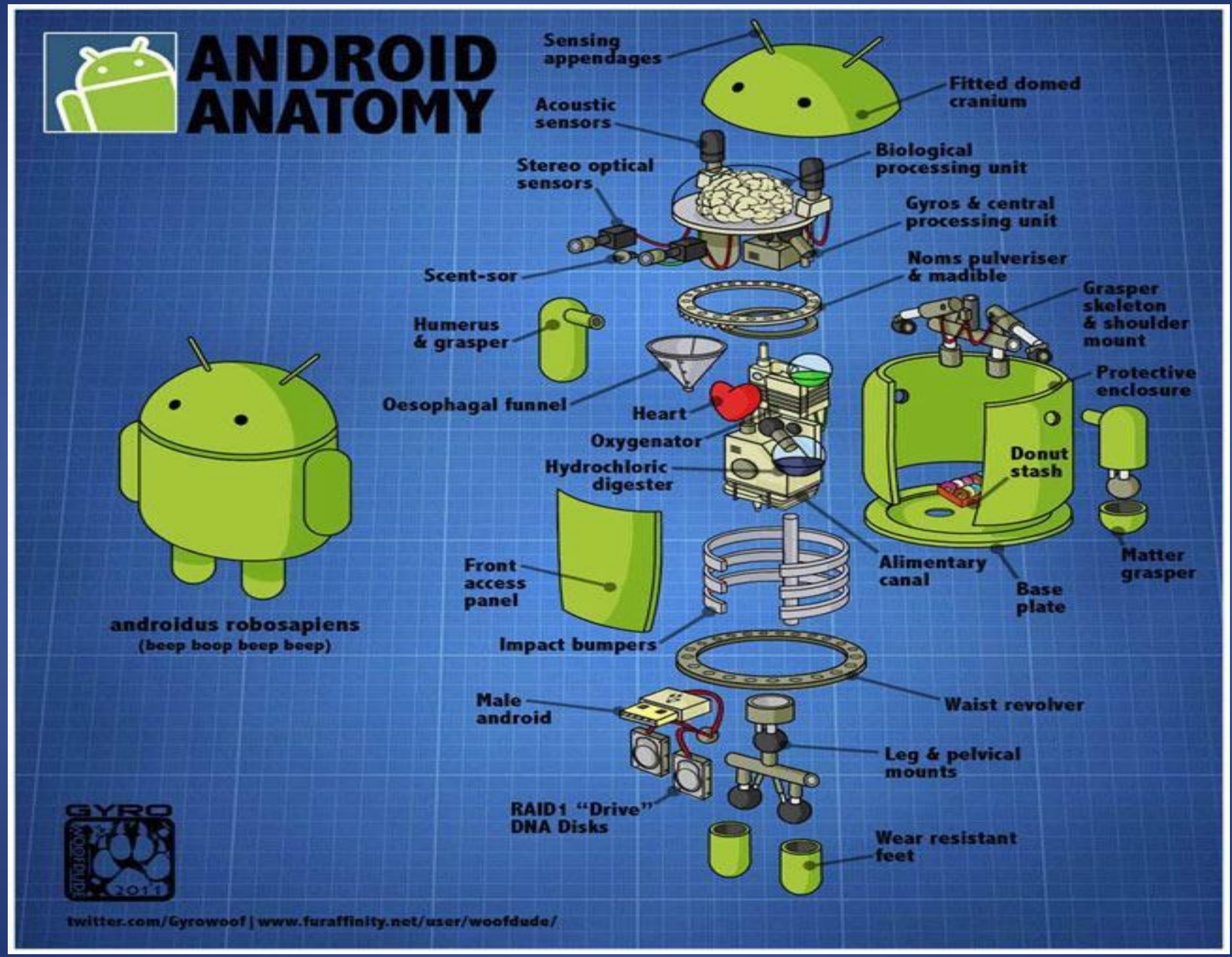
Android OS - Introduction

- Linux-based (v2.6 Kernel), open source, free
- Operating system, middleware and key mobile applications
- Originally founded by Android Inc. in 2003
- Purchased and developed by Google since 2005
- Open Handset Alliance
- Apache v2 license

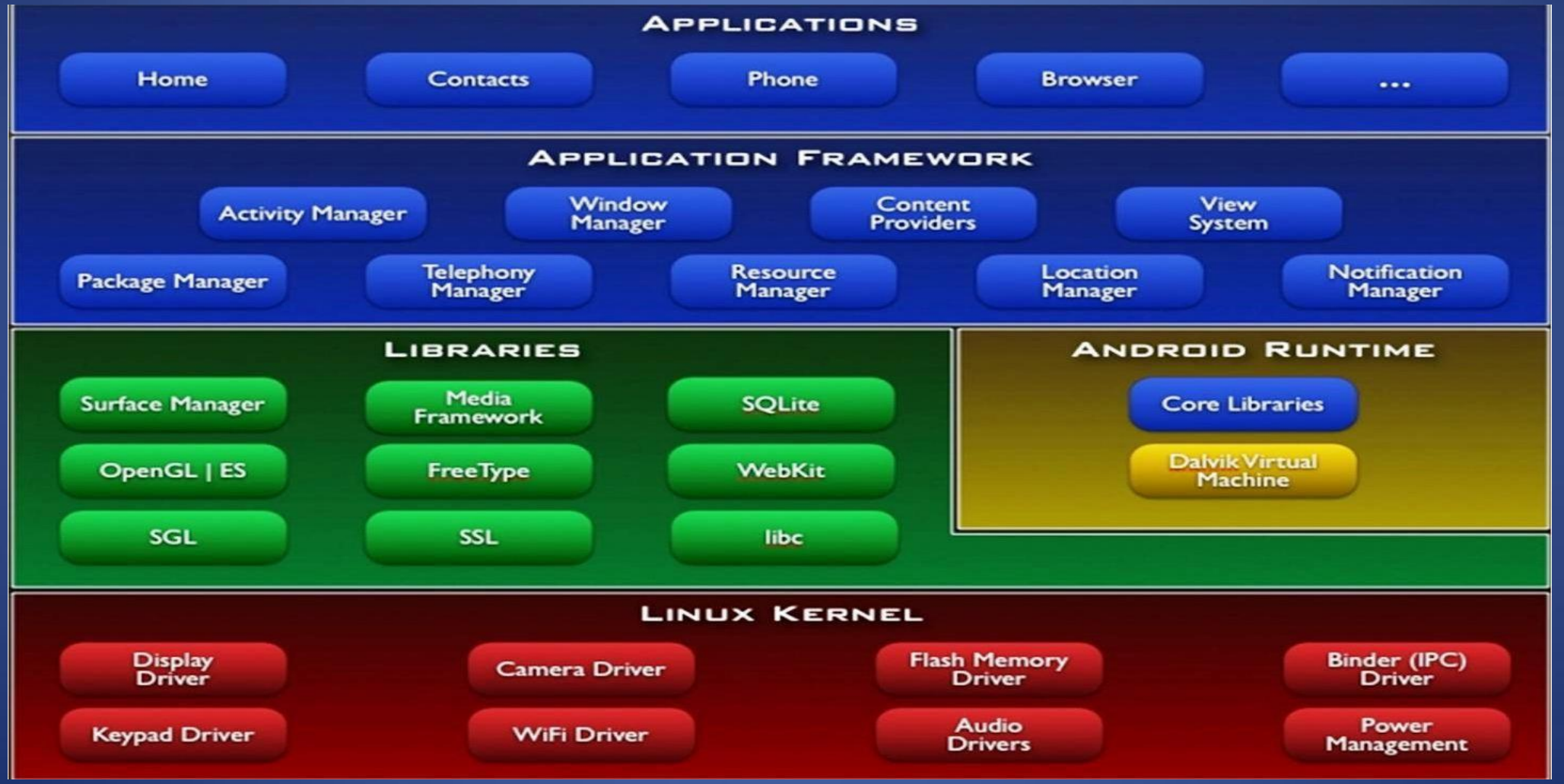
Open Handset Alliance

Android OS

- Other uses of Android OS


ANDROID ANATOMY
Sensing appendages
Fitted domed cranium
Acoustic sensors
Biological processing unit
Stereo optical sensors
Gyros & central processing unit
Noms pulveriser & madible
Scent-sor
Grasper skeleton & shoulder mount
Humerus & grasper
Protective enclosure
Oesophagal funnel
Heart
Oxygenator
Donut stash
Hydrochloric digester
Front access panel
Alimentary canal
Matter grasper
Base plate
Impact bumpers
Waist revolver
Male android
Leg & pelvical mounts
RAID1 "Drive" DNA Disks
Wear resistant feet
androidus robosapiens
(beep boop beep beep)
GYRO
2011
twitter.com/Gyrowoof | www.furaffinity.net/user/woofdude/

Android OS - Architecture

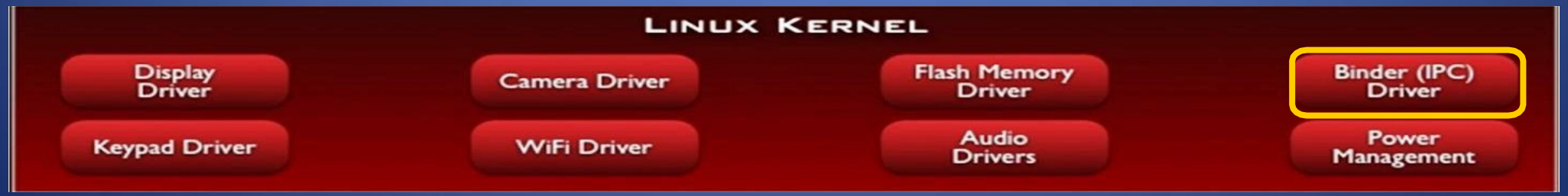


Android OS - Architecture

- Linux Kernel (2.6.24)
  - Android is not Linux
  - Only kernel portion of Linux
  - Enchancements to support Android
  - GNU utility packages ported to ARM
  - Abstraction layer between Hardware and Software
  - No native windowing system (X11)

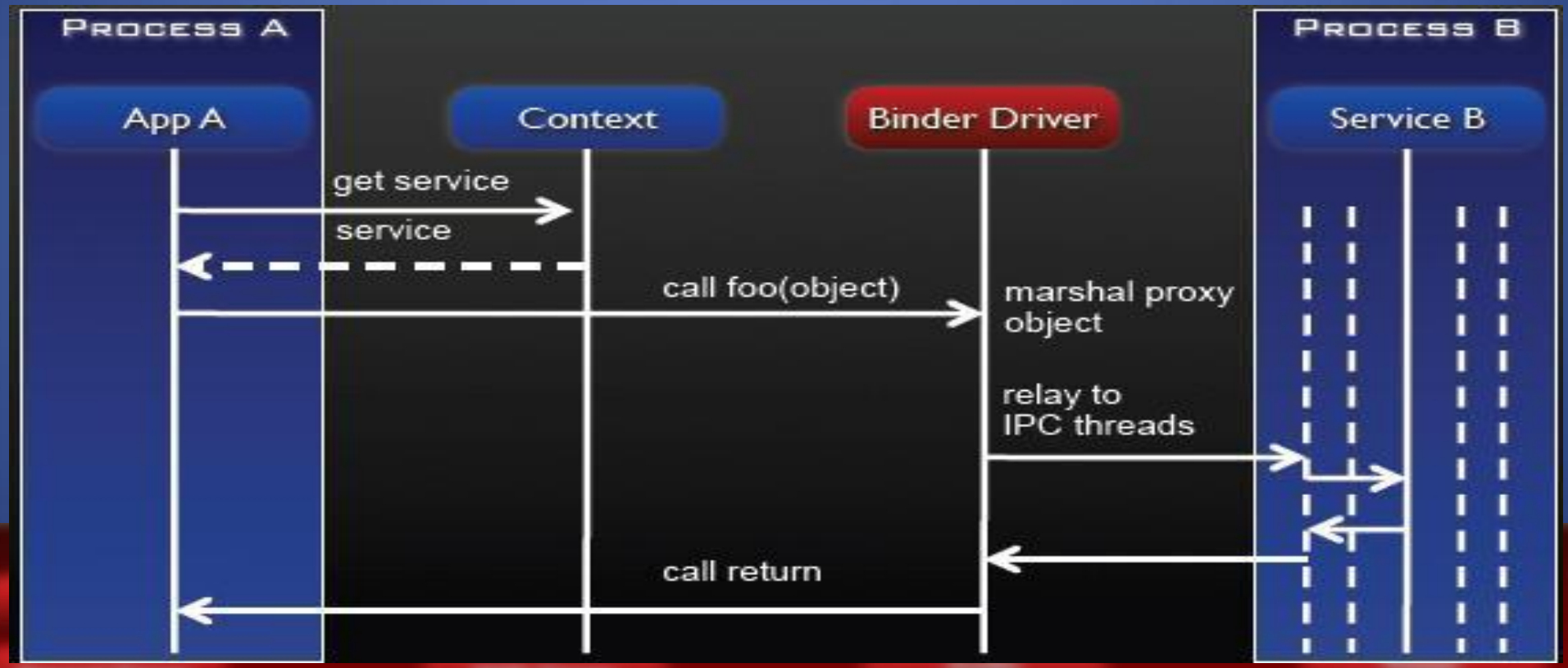
Android OS - Architecture

- Binder Driver
  - InterProcess Communication between applications
  - Map process memory address to kernel address
  - ioctl()
  - Synchronous calls between processes
  - AIDL (Android Interface Definition Language)



Android OS - Architecture

- Binder in action

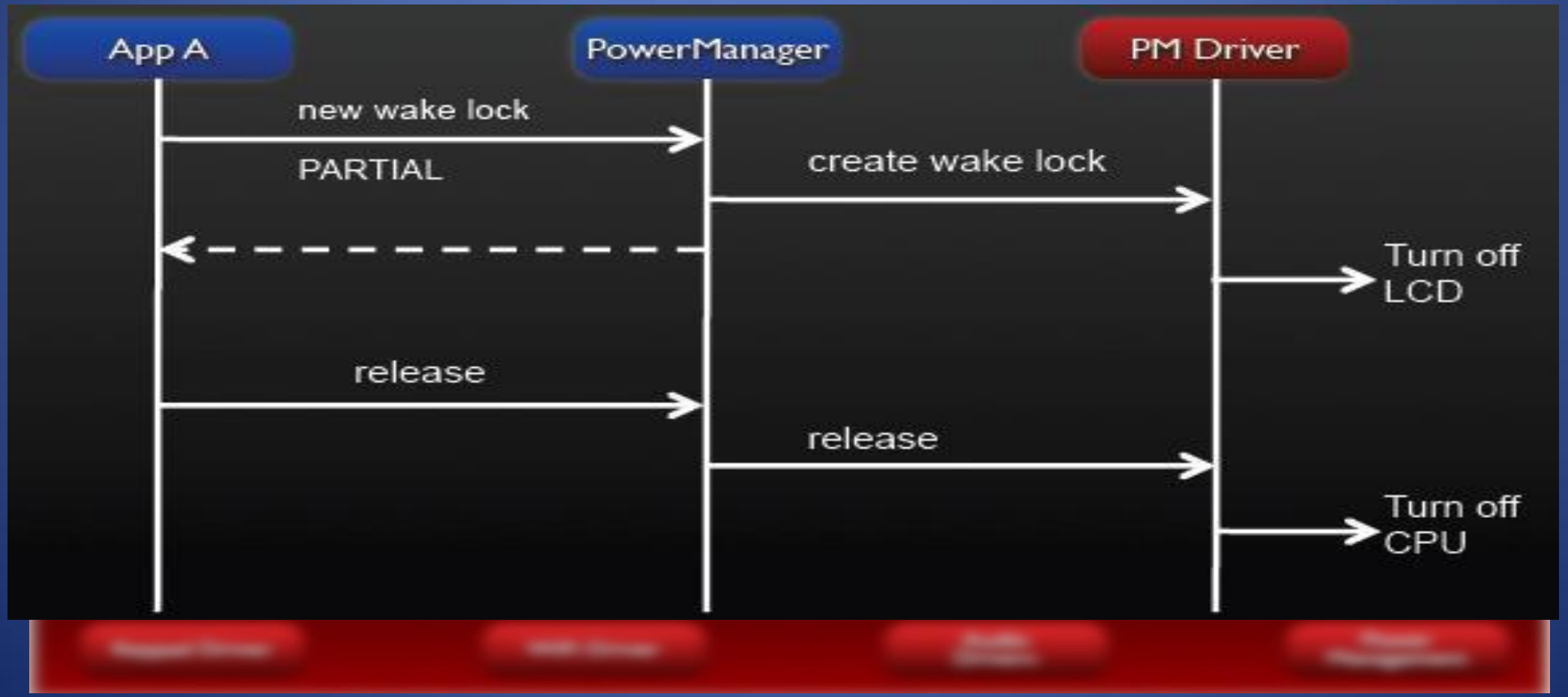


Android OS - Architecture

- Power Management
  - Battery power →Limited capacity
  - Built on top of Linux PM
  - Wake locks – keep power on
    - PARTIAL_WAKE_LOCK (CPU on, screen/keyboard off)
    - SCREEN_DIM_WAKE_LOCK (CPU on, screen dim, keyboard off)
    - SCREEN_BRIGHT_WAKE_LOCK (CPU on, screen bright, kb off)
    - FULL_WAKE_LOCK (CPU on, screen on, keyboard bright)

Android OS - Architecture

- Power Management in action



Android OS - Architecture

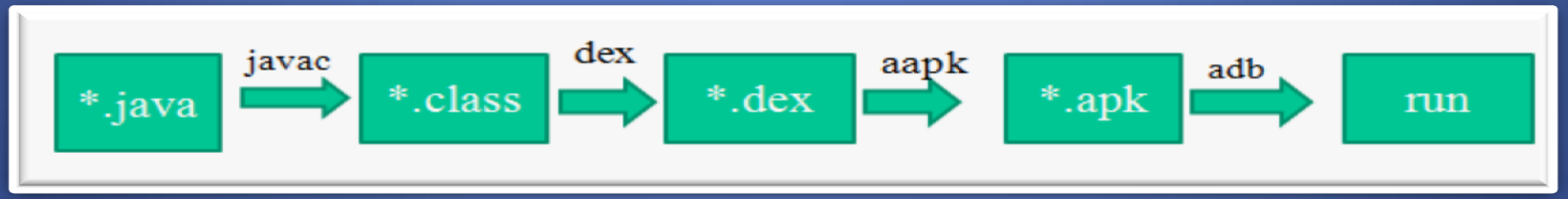
- Other kernel features
  - Android shared memory (ashmem)
  - Process memory allocator (pmem)
  - System logging facility (logger)
  - Alarm timers
  - Paranoid network security
  - RAM_CONSOLE (save kernel messages to RAM)

Android OS - Architecture

- Native Libraries (C/C++ libraries)
  - Custom libc: Bionic
  - WebKit: Web Browser kernel
  - Media Framework: PacketVideo OpenCORE platform
  - SQLite: Light weight, SQL syntax database

Android OS - Architecture

- Android Runtime
  - Core Libraries: Core APIs for Java
    - Data structures, Utilities, File/Network access, graphics
  - Dalvik Virtual Machine



Android OS - Architecture

- Application Framework
  - Core platform services
    - Activity/Package/Window/Resource Manager
  - Hardware Services
    - Access to lower-level API through location Manager
    - Telephony/Bluetooth/WiFi/USB/Sensor Service

Android OS - Architecture

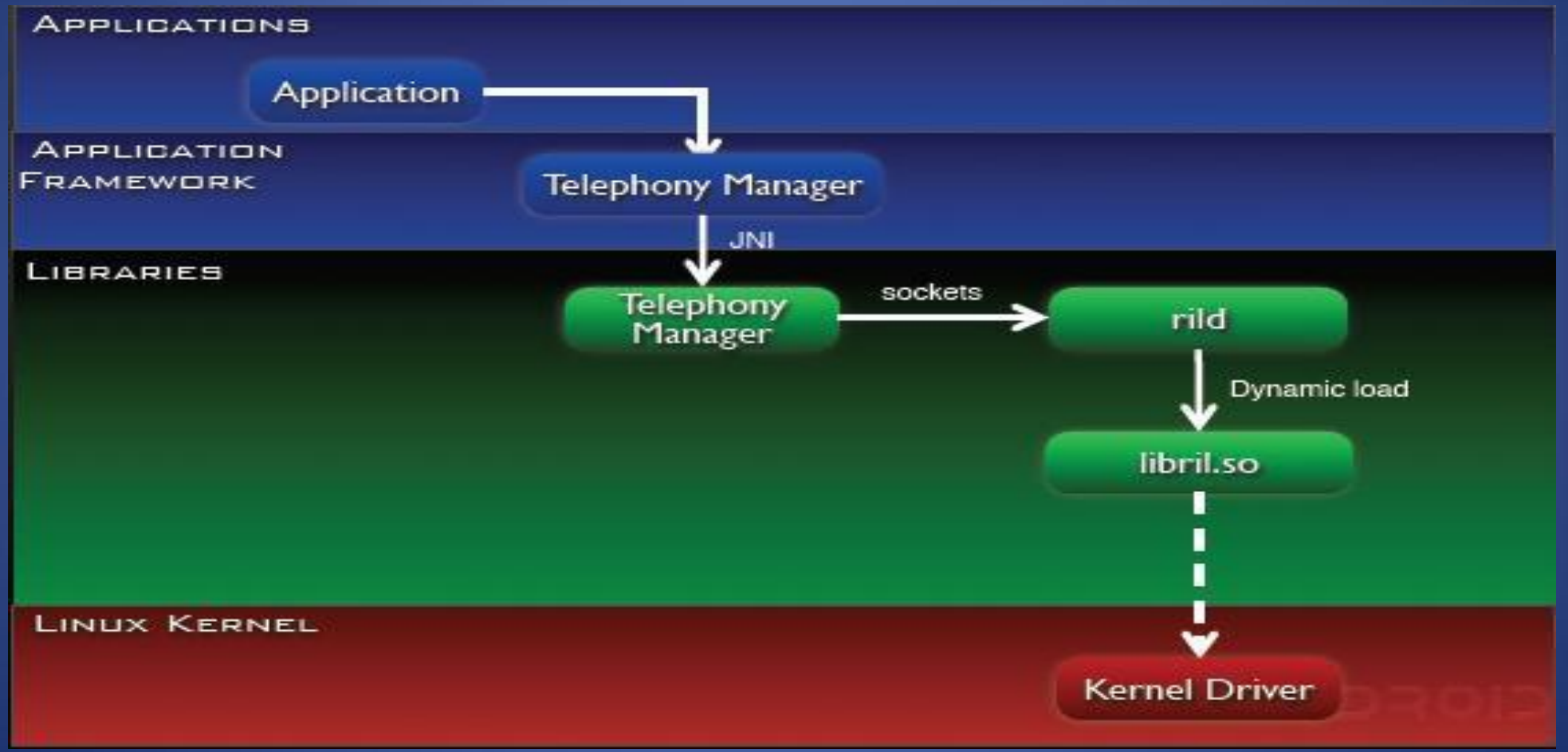
- Application Framework

Feature	Role
View System	Used to build an application, including lists, grids, text boxes, buttons, and embedded web browser
Content Provider	Enabling applications to access data from other applications or to share their own data
Resource Manager	Providing access to non-code resources (localized strings, graphics, and layout files)
Notification Manager	Enabling all applications to display customer alerts in the status bar
Activity Manager	Managing the lifecycle of applications and providing a common navigation backstack

Android OS - Architecture

- Applications
  - Built-in Core Applications
    - Email client, SMS, Calendar, Maps, Contacts, Browser…
  - User implemented Applications
    - Written in Java
    - Every application has its own process
    - Can be killed to reclaim resources

Android OS - Architecture



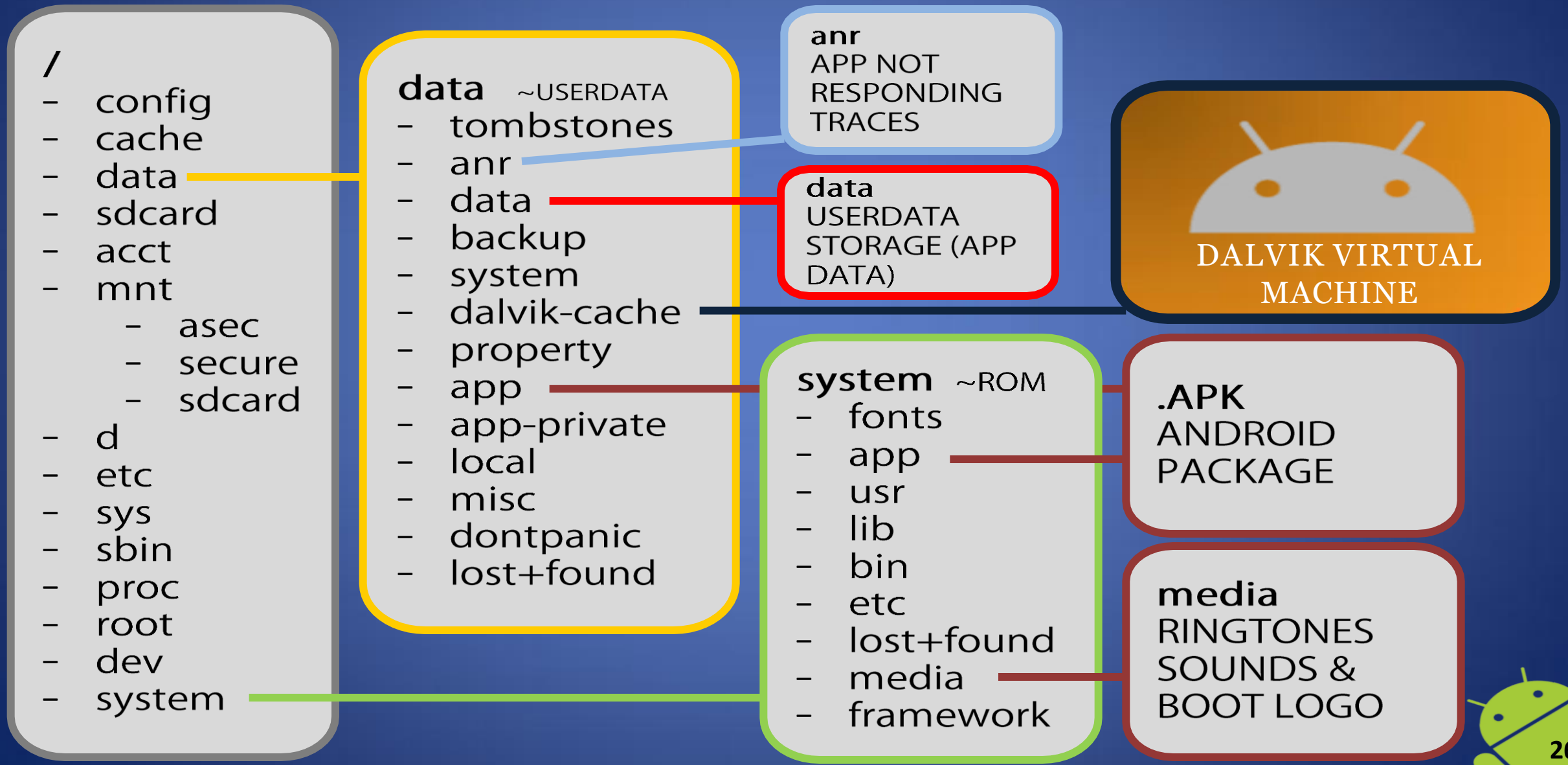
Android OS - Application development

- Tools needed: Android SDK, Java JDK, Eclipse, Android Development Tools plugin
- Application components:
  - **Activities**: Interactive Tasks
  - **Services**: Non-interactive Tasks
  - **Content providers**: Database Server
  - **Broadcast receivers**: Capture event responses
  - **Intents**: Component activation mechanism
- Device Emulator inside Android SDK (qEmu)

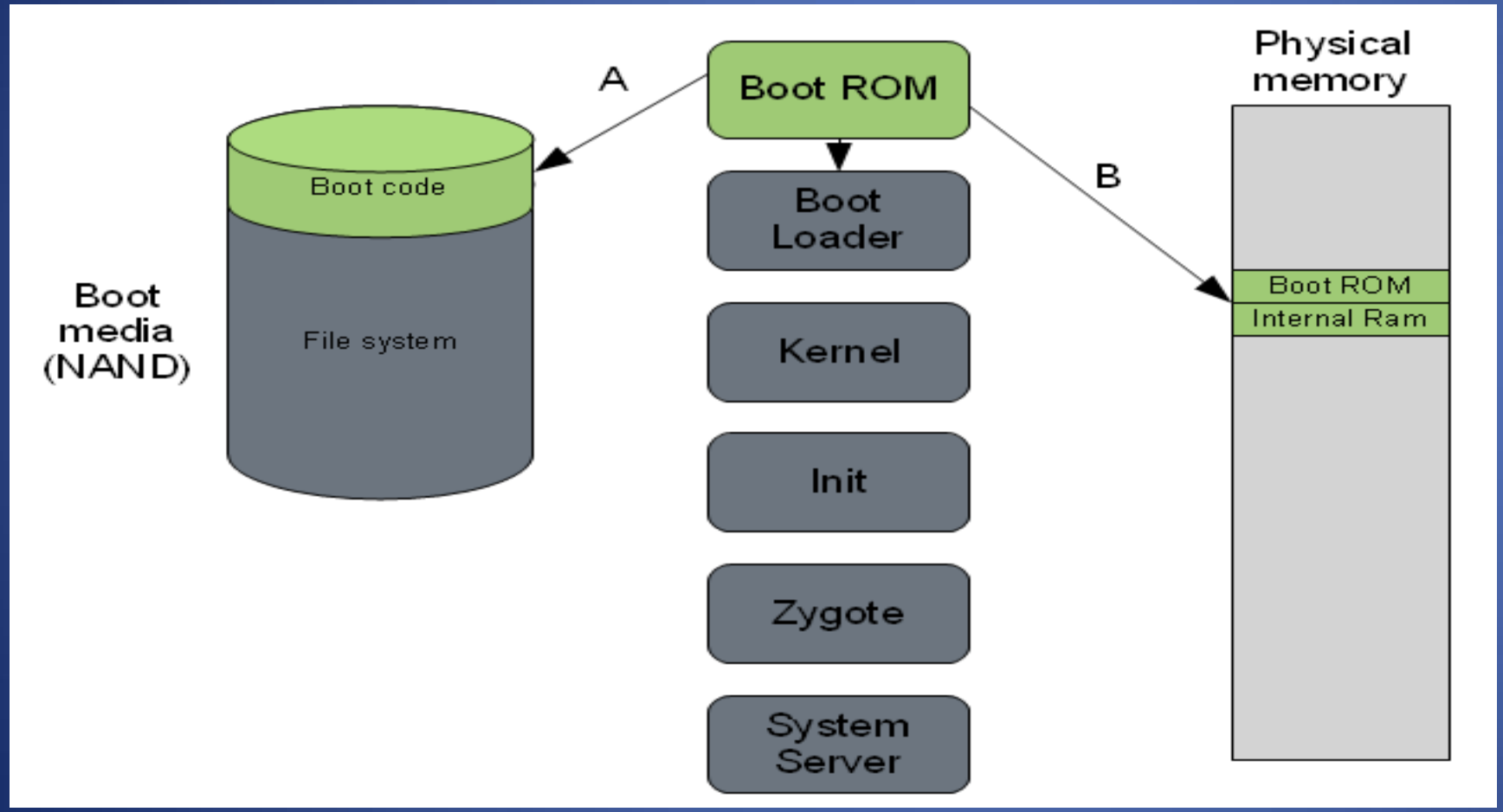
Android OS - File system

- Supports Linux filesystems:
  - ext2, ext3, ext4
- YAFFS (Yet Another Flash File System)
  - NAND chips with 512 byte pages

Android OS - File system

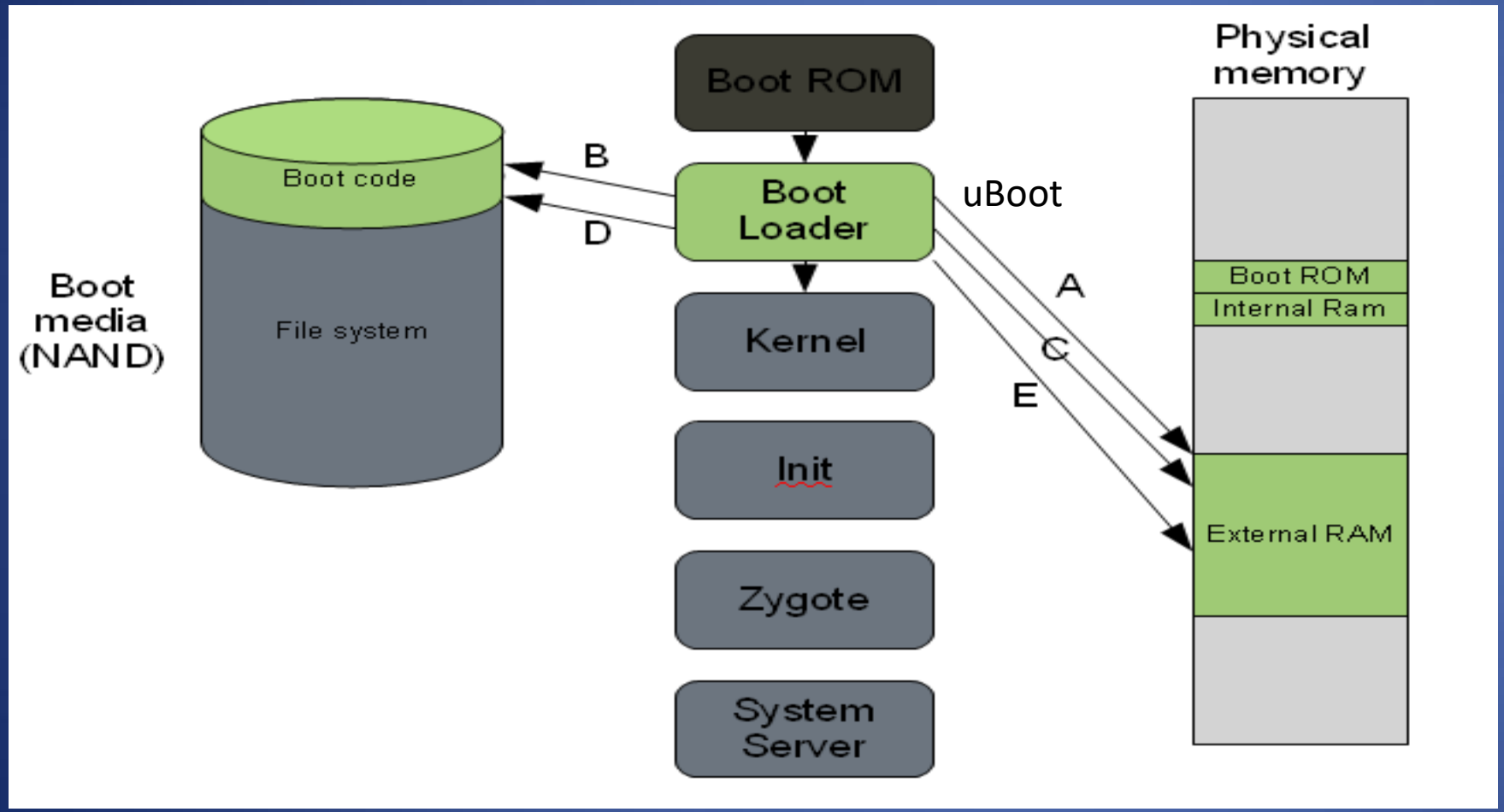


Android OS - Boot process



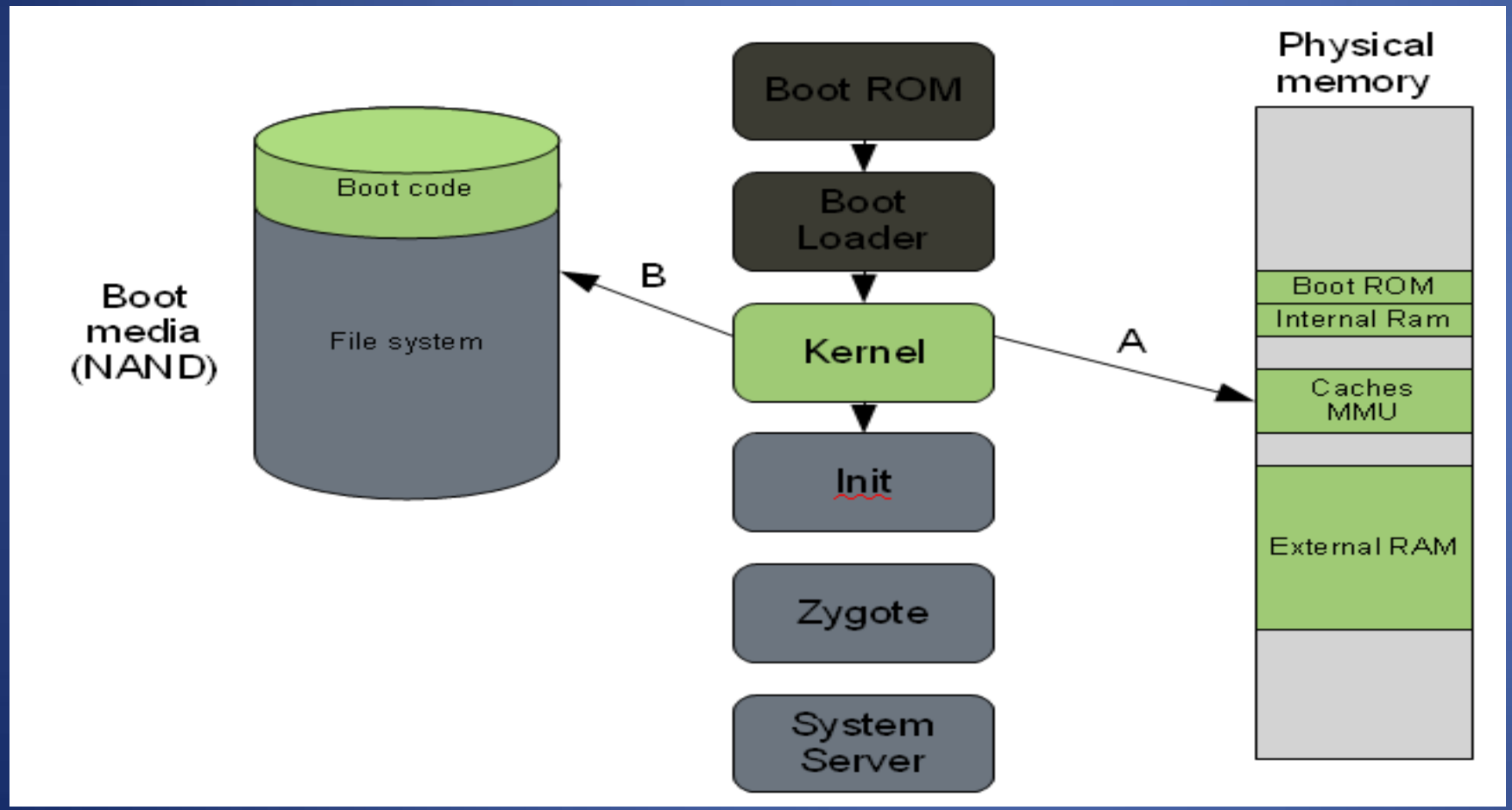
- ✓ ROM → Boot code
- ✓ Boot media available
- ✓ Boot loader → RAM

Android OS - Boot process



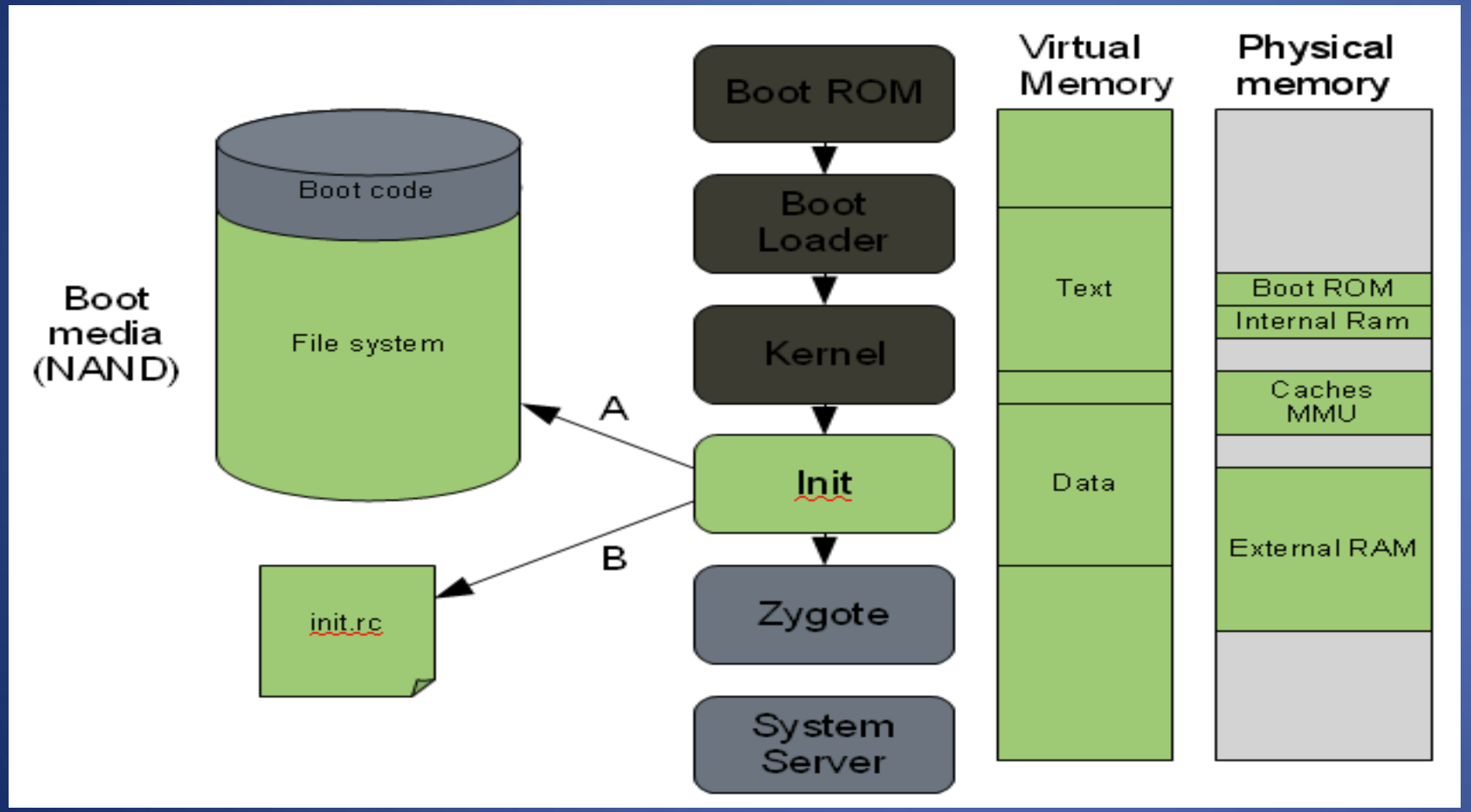
- ✓ Initial memories
- ✓ Kernel → RAM
- ✓ File system
- ✓ Additional memory
- ✓ Network support
- ✓ Modem
- ✓ CPU
- ✓ Low level memory protections
- ✓ Kernel address space
  - ✓ jump

Android OS - Boot process



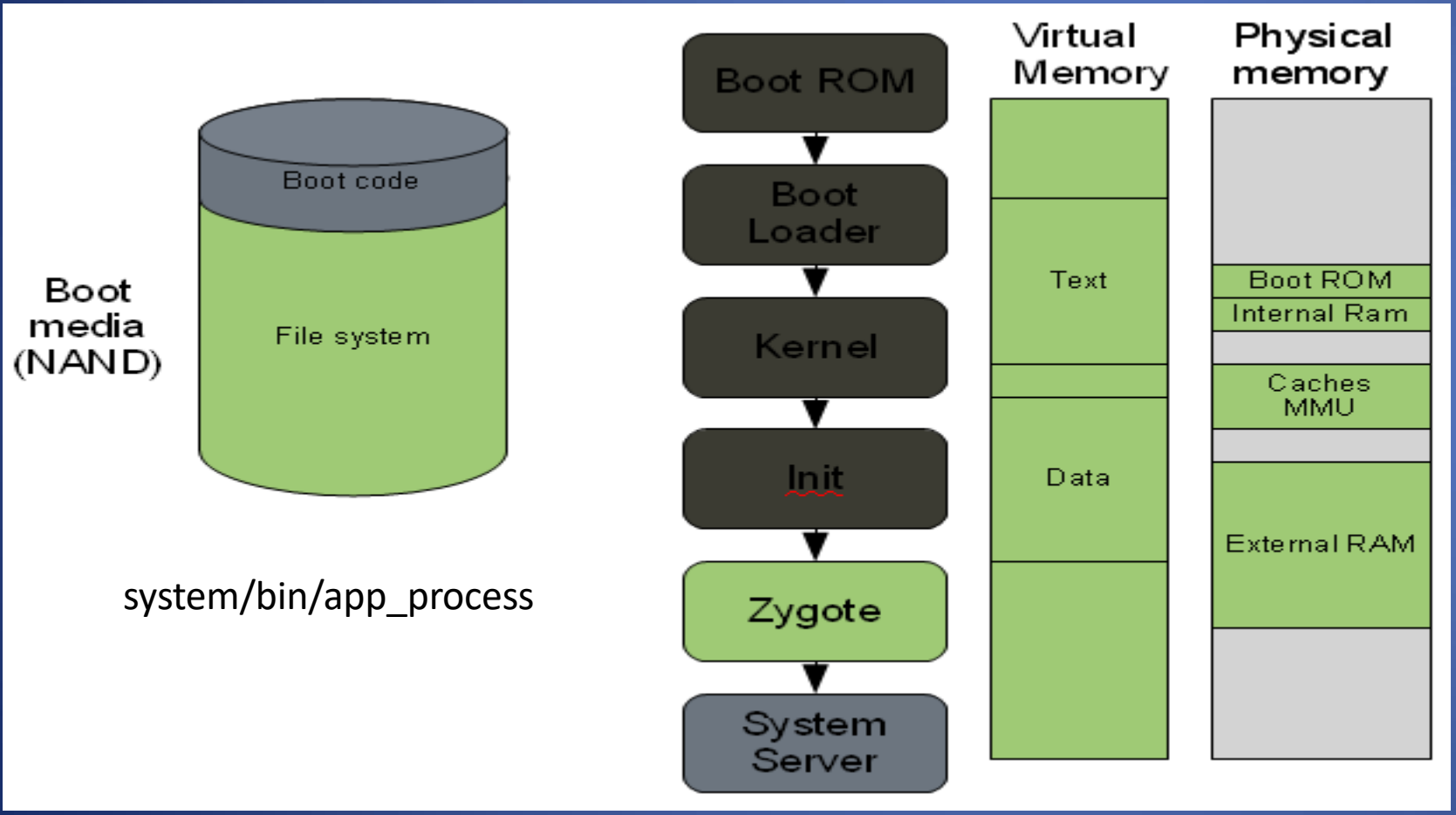
- ✓ Interrupt controllers
- ✓ Memory protections
- ✓ Caches and scheduling
- ✓ Virtual memory
- ✓ User space processes
- ✓ init

Android OS - Boot process



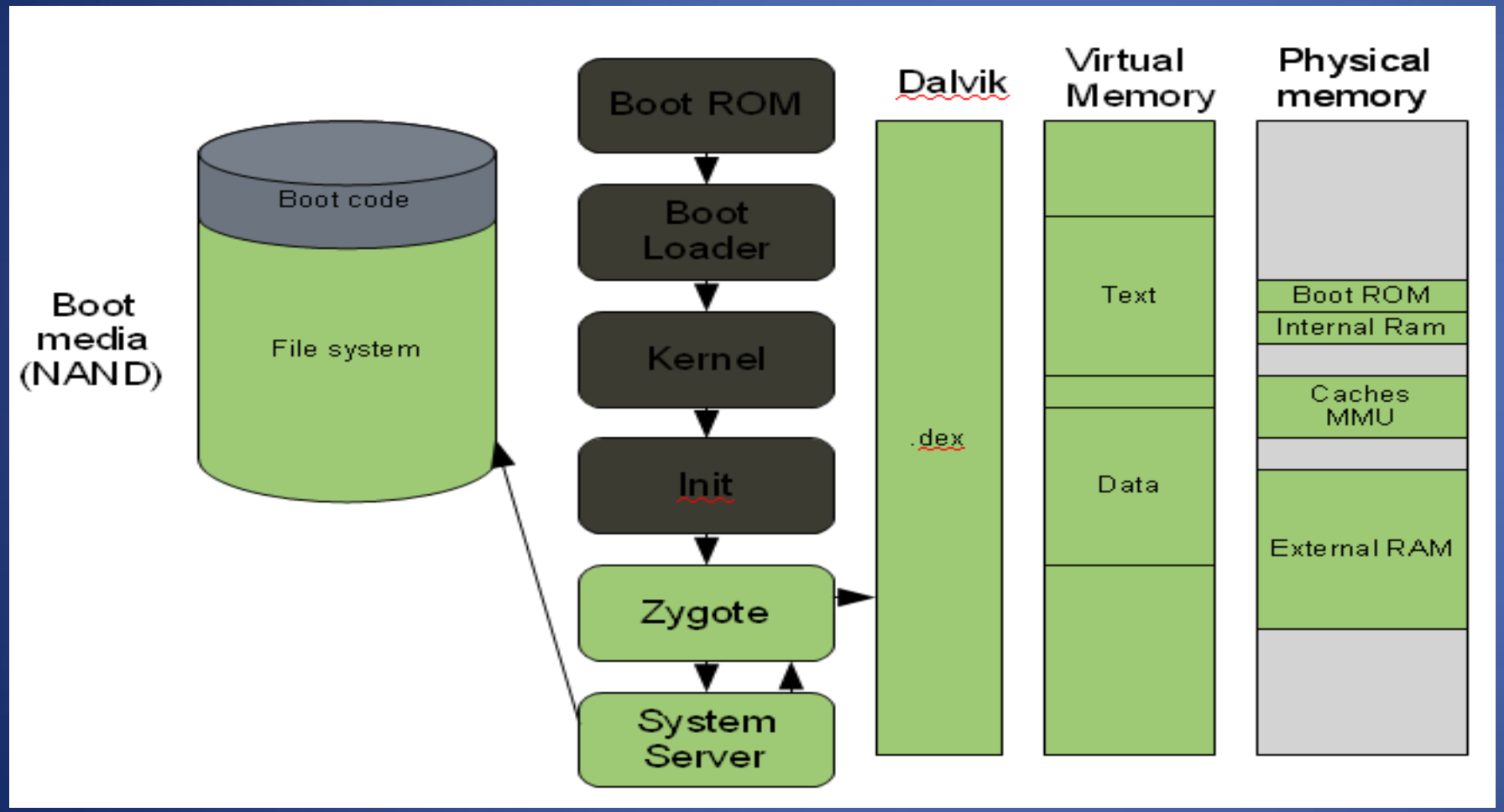
- ✓ init.rc → service processes

Android OS - Boot process



- ✓ Zygote → VM
- ✓ Socket for input
- ✓ Zygote.fork() → VM for child process

Android OS - Boot process



- ✓ System server → Android services
- ✓ Telephony
- ✓ Bluetooth
- ✓ WiFi
- ✓ …
- ✓ User installed apps

Broadcast signal: ACTION_BOOT_COMPLETED

Android OS - Boot process

Android Hardware

- Device Requirements

Feature	Minimum Requirement
Chipset	ARM-based
Memory	128 MB RAM; 256 MB Flash External
Storage	Mini or Micro SD
Primary Display	QVGA TFT LCD or larger, 16-bit color or better
Navigation Keys	5-way navigation with 5 application keys, power, camera and volume controls
Camera	2MP CMOS
USB	Standard mini-B USB interface
Bluetooth	1.2 or 2.0

Android Hardware – System on Chip

Phone Manufacturers / System on Chip Provider	
Motorola	Texas Instruments OMAP / NVIDIA Tegra 2 (newer dual core phones)
Samsung	Samsung Hummingbird / Exynos
HTC	Qualcomm Snapdragon
LG	Qualcomm Snapdragon / Texas Instruments OMAP 4 (newer dual core phones)
Dell	Qualcomm Snapdragon
Sony Ericcsson	Qualcomm Snapdragon

HTC Nexus One		
Chipset	**CPU**	**GPU**
Snapdragon Gen1	1 GHz ARM Cortex-A8	Adreno 200

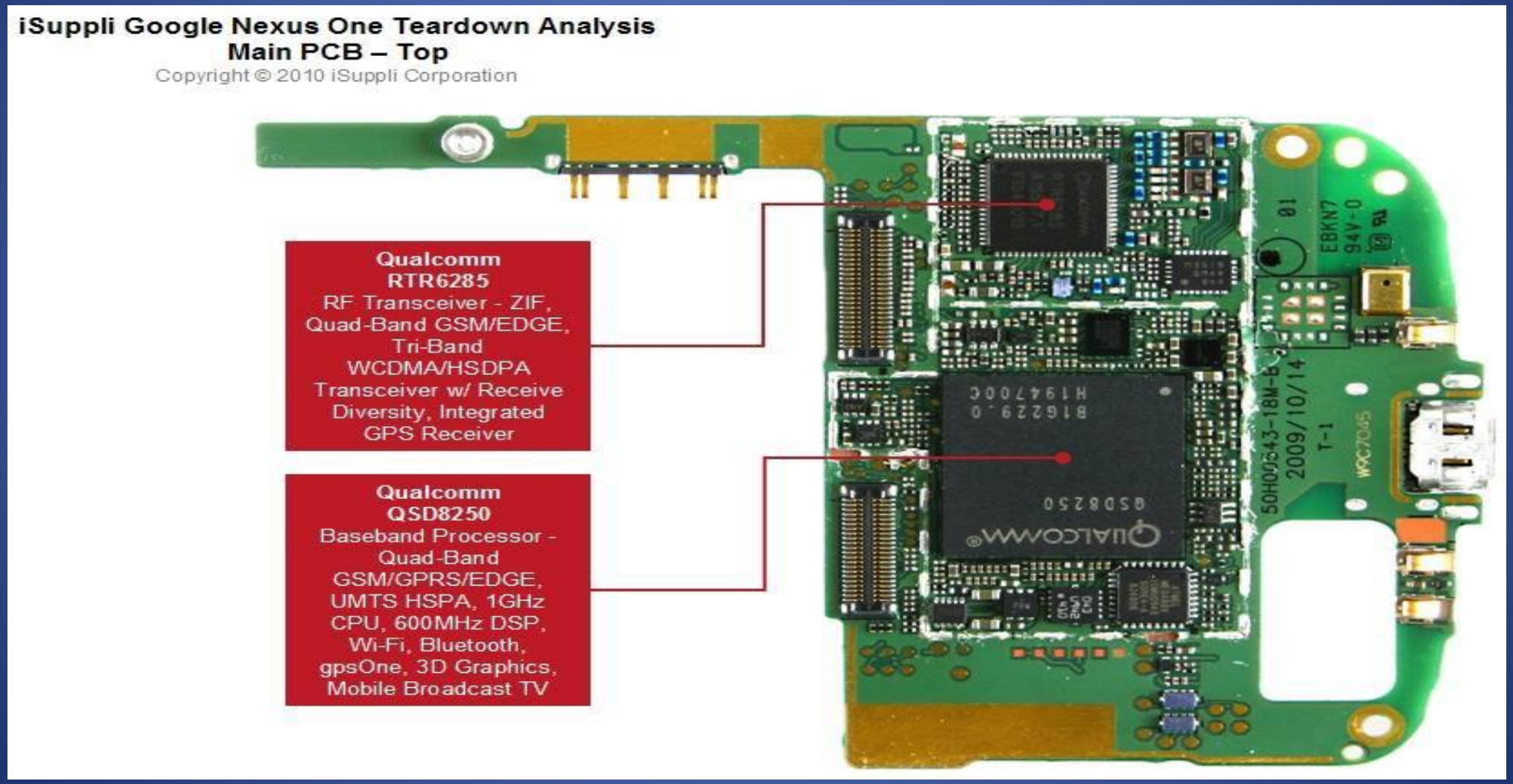
*Android Hardware Comparison Chart

Android Hardware - Chipsets

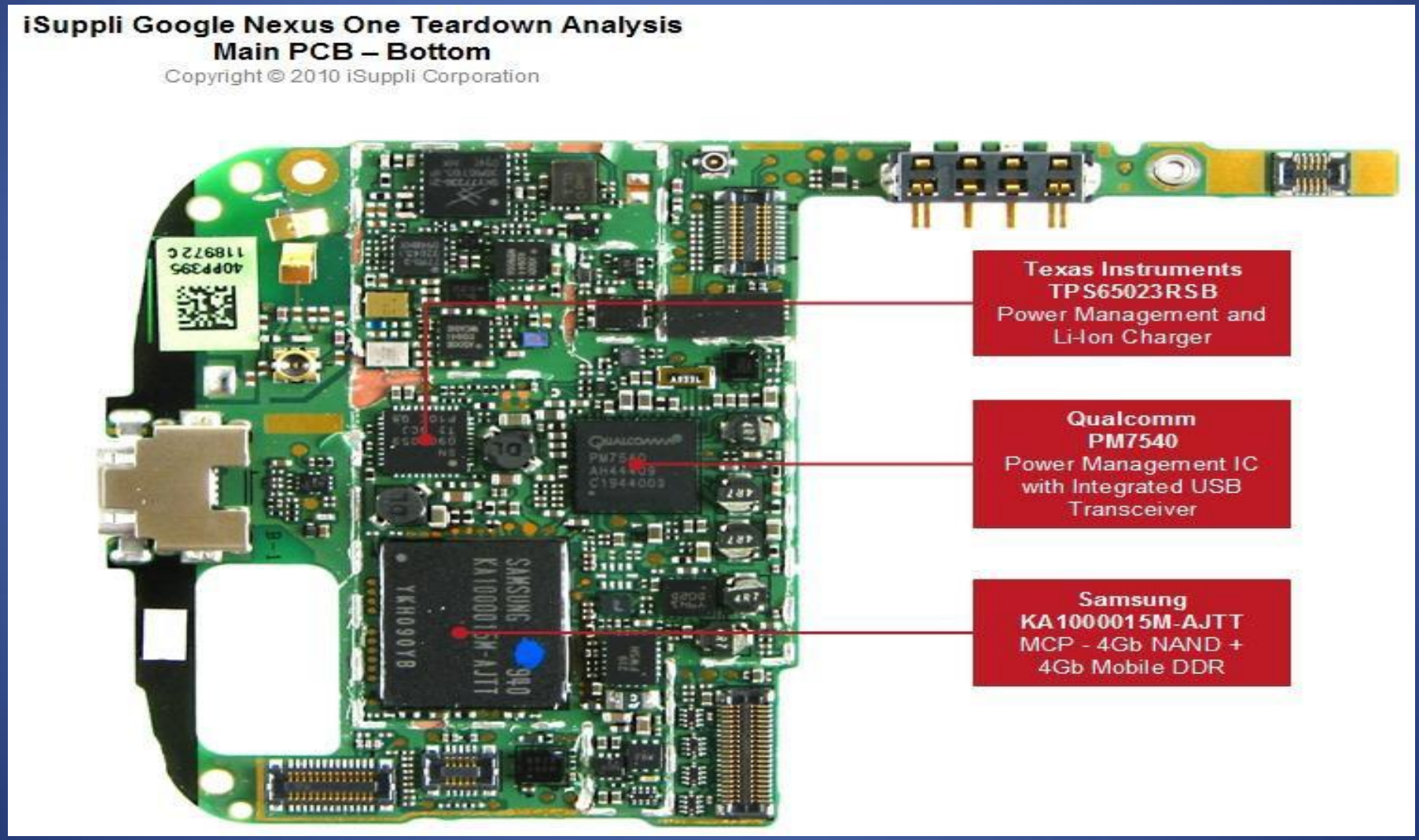
ARM CPU Specifications	
CPU	**Feaures**
ARM11	1.2 DMIPS per MHz (Dhrystone MIPS) Frequency of 528-600 MHz 8-stage pipeline 90nm process technology
ARM Cortex-A8	2 DMIPS per MHz (Dhrystone MIPS) Frequency from 600 MHz to 1 GHz In-order execution pipeline 13-stage pipeline 65/45nm process technology
ARM Cortex-A9	2.5 DMIPS per MHz (Dhrystone MIPS) Frequency up to 2 GHz Out-of-order execution pipeline NEON SIMD instruction set extension (OMAP 4) High performance VFPv3 Floating Point Unit (Tegra 2) 9-stage pipeline
	Support for up to 4 cores 40nm process technology

AMD Adreno	
GPU	**Feaures**
Adreno 200	17M triangles/sec
Adreno 205	41M triangles/sec 245M pixels/sec 720p video recording and playback up to 30 frames/second
Adreno 220	88M triangles/sec 532M pixels/sec 1080p video recording and playback up to 30 frames/second

Android Hardware – Nexus One



Android Hardware – Nexus One



Android Hardware – Nexus One

Android Hardware – Nexus One

Component	Manufacturer	Description
Baseband Processor	Qualcomm	Quad-Band GSM/GPRS/EDGE, UMTS HSPA, 1GHz CPU, 600MHz Digital Signal Processor
Memory	Samsung Semiconductor	Multichip Package (4Gbit NAND Flash + 4Gbit Mobile Double Data Rate (DDR) DRAM
Bluetooth/WLAN	Broadcom	Bluetooth / WLAN / FM Transmitter/Receiver (802.11a/b/g/n, Bluetooth V2.1+EDR, 65nm)
Power Management	Qualcomm	Power Management IC (w/ Integrated USB Transceiver)
Radio Frequency Transceiver	Qualcomm	RF Transceiver (ZIF, Quad-Band GSM/EDGE, Tri-Band WCDMA/HSDPA)
Power Amplifier	Skyworks & Others	4 Power Amplifier Modules (Skyworks & Other)
Power Management	Texas Instruments	Power Management & Li-Ion Charger
Display	Samsung Mobile Display	Display (3.7" AM-OLED)
Touchscreen	Synaptics	Touchscreen Assembly (Capacitive Multitouch)
Electrical		Misc. Electronic Components (Small IC's, Discrete Semiconductors, Passives, etc.)
Camera		Camera (5.0 MP Auto Focus)
MicroSD Card		MicroSD Card (4GB)
Electro-Mechanical		Misc. Electromechanical Components (Connectors, Acoustics, Antennas, etc.)
Electro-Mechanical		PCB's
Mechanical		Misc. Mechanical Components (Plastics, Metals, Hardware, Shielding, Insulation, etc.)
Battery		Battery (1400mAh, 3.7V)
Mechanical		Main Enclosure Housing (Machined Aluminum Unibody)

Focus on

- Testing applications on:
  - SDK Emulator
  - Real device
  - Virtual Machine running Android
- Share experience
- Compare metrics:
  - CPU usage
  - Memory
- Using low level commands (adb)

References

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