Overview of Android (Part 1): Hardware & OS Kernel Layers

Douglas C. Schmidt
d.schmidt@vanderbilt.edu
www.dre.vanderbilt.edu/~schmidt

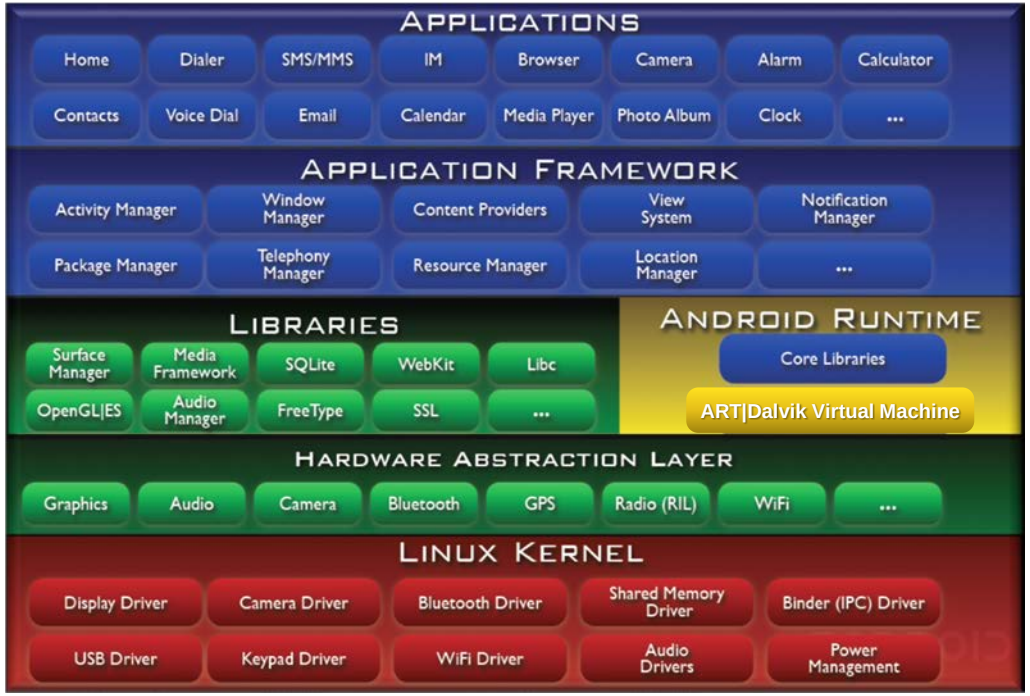
Professor of Computer Science

Institute for Software Integrated Systems

Vanderbilt University
Nashville, Tennessee, USA

Learning Objectives in this Part of the Lesson

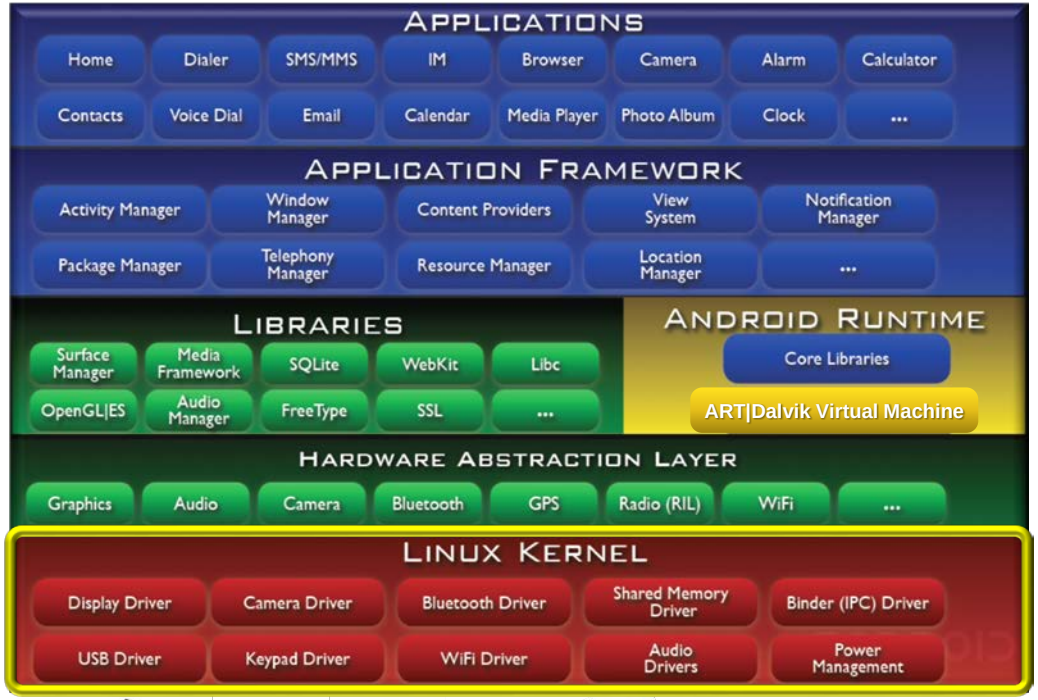
1. Understand common hardware elements in Android
   - e.g., sensors, transceivers, storage, & processors



Hardware components

Learning Objectives in this Part of the Lesson

1. Understand common hardware elements in Android
2. Recognize key characteristics of the Android Linux kernel
   - e.g., its purpose & its extensions to GNU Linux

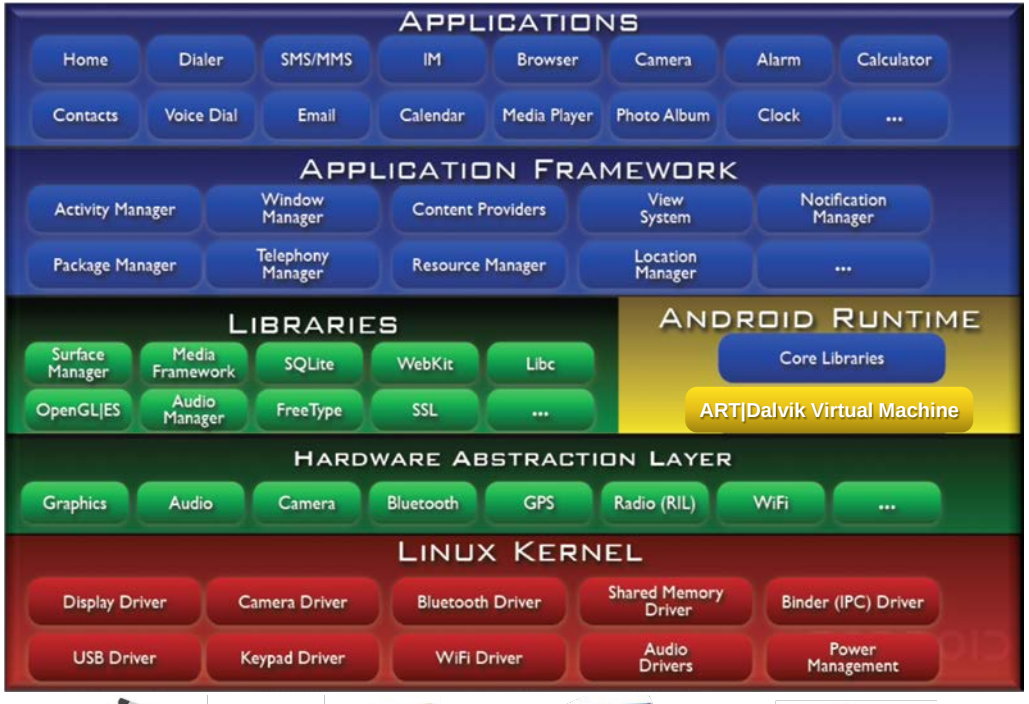


Hardware components

Overview of Android Hardware

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements



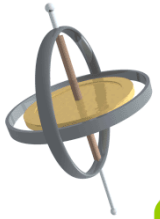


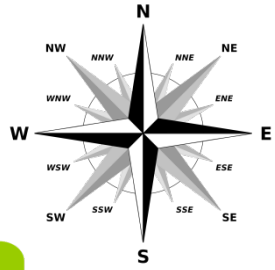

Hardware components

See static.googleusercontent.com/media/source.android.com/en/compatibility/android-cdd.pdf

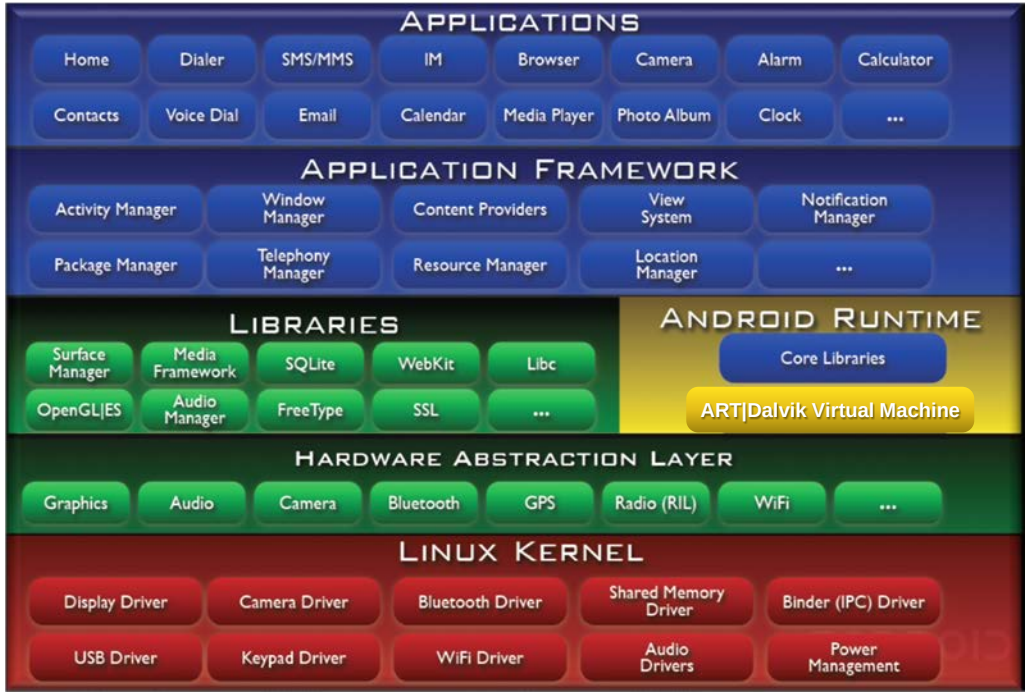
Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors





Sensors detect events or changes in the environment

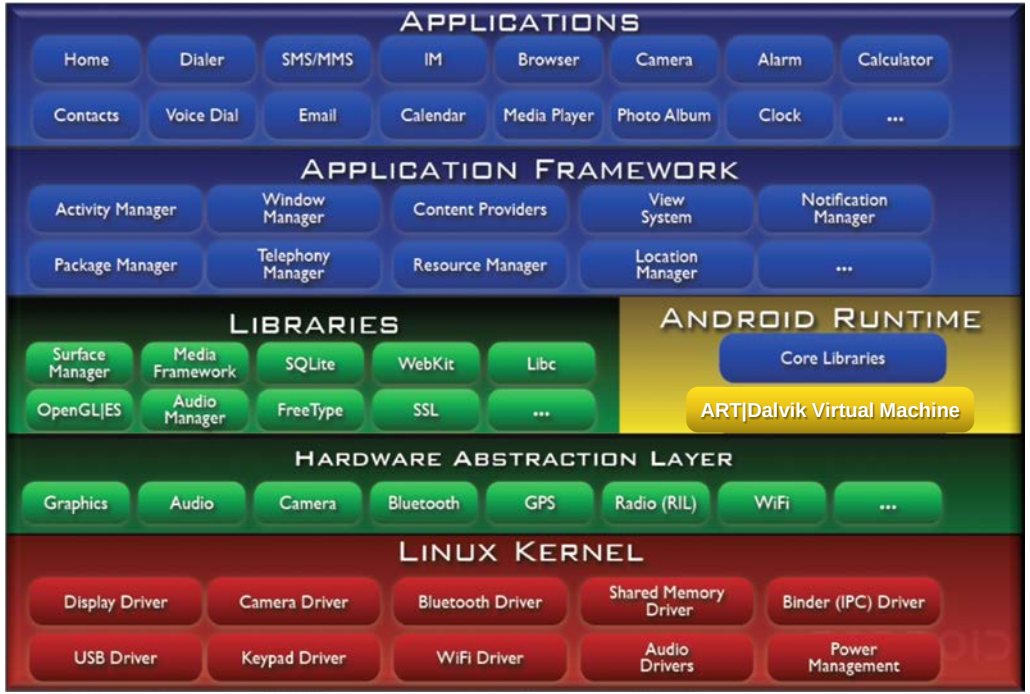


Hardware components

See developer.android.com/guide/topics/sensors/sensors_overview.html

Overview of Android Layers: Hardware

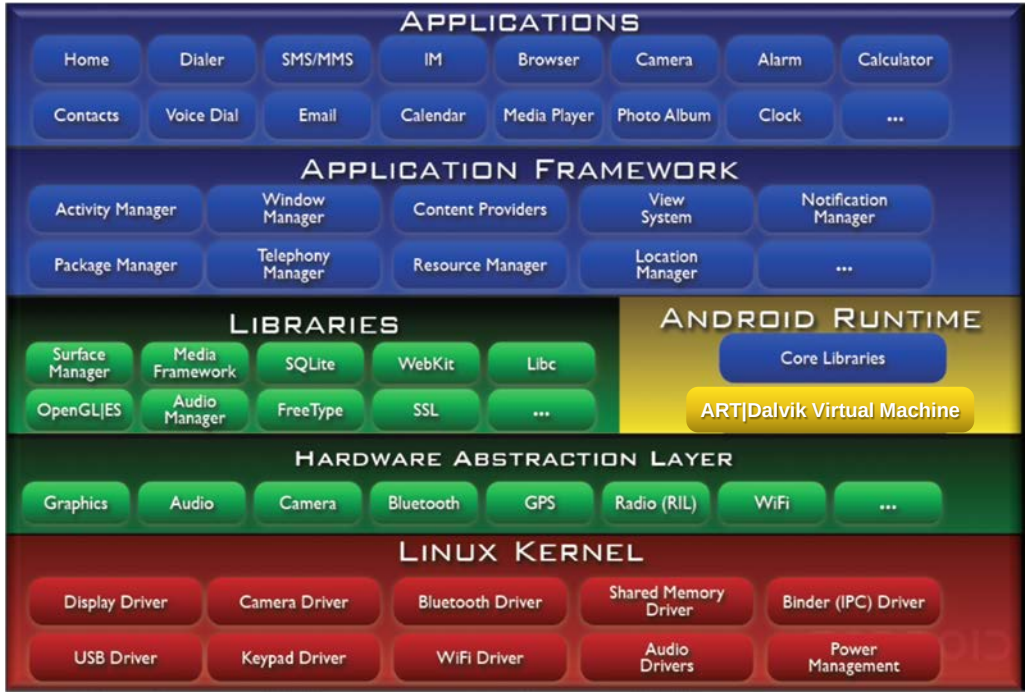
- Android devices are built upon a range of hardware elements, e.g.
  - Sensors, e.g.
    - Motion sensors measure acceleration forces & rotation
      - e.g., accelerometers & gyroscopes



Hardware components

Overview of Android Layers: Hardware

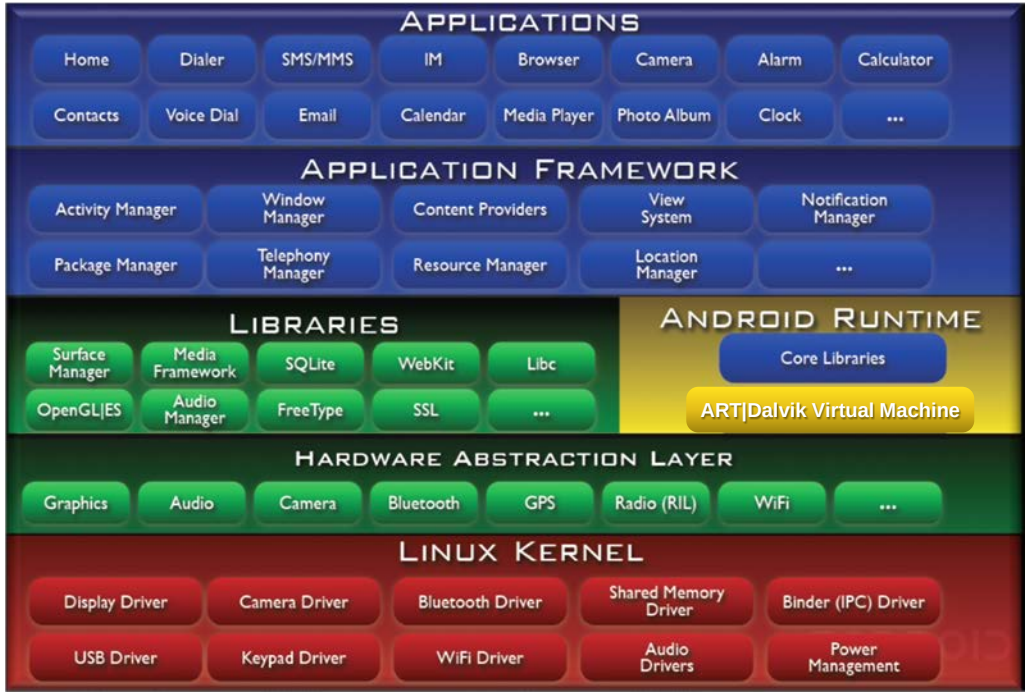
- Android devices are built upon a range of hardware elements, e.g.
  - Sensors, e.g.
    - Motion sensors measure acceleration forces & rotation
    - Environment sensors measure temperature, pressure, & humidity
      - e.g., thermometers & barometers



Hardware components

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors, e.g.
    - Motion sensors measure acceleration forces & rotation
    - Environment sensors measure temperature, pressure, & humidity
  - Position sensors measure the physical position of a device
    - e.g., magnetometers

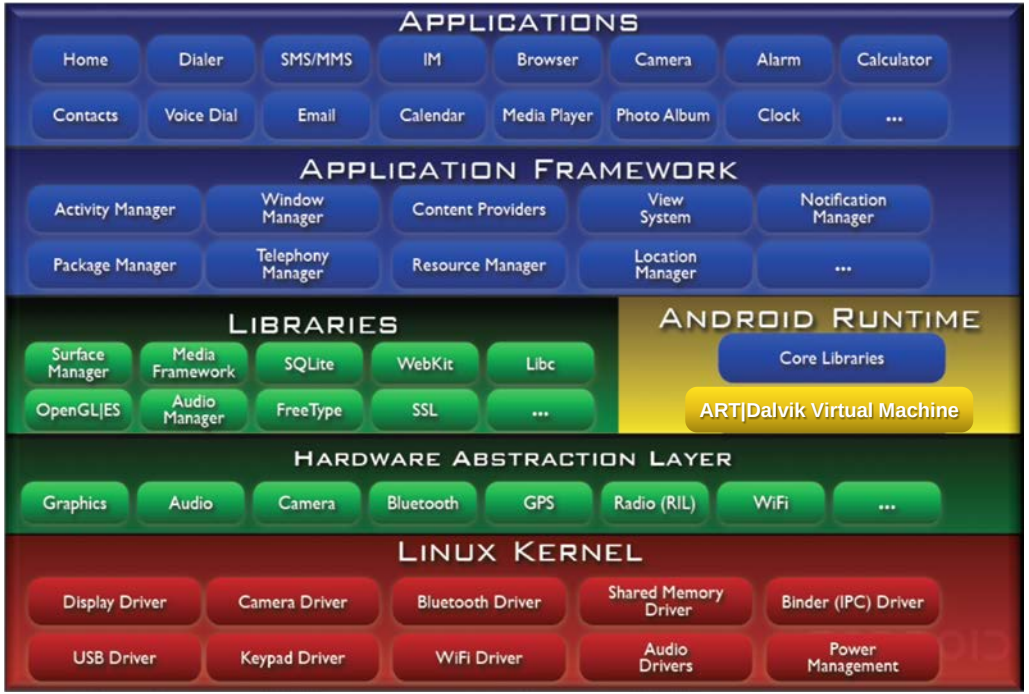


Hardware components

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors
  - Transceivers

A transceiver is a device comprising both a transmitter & a receiver



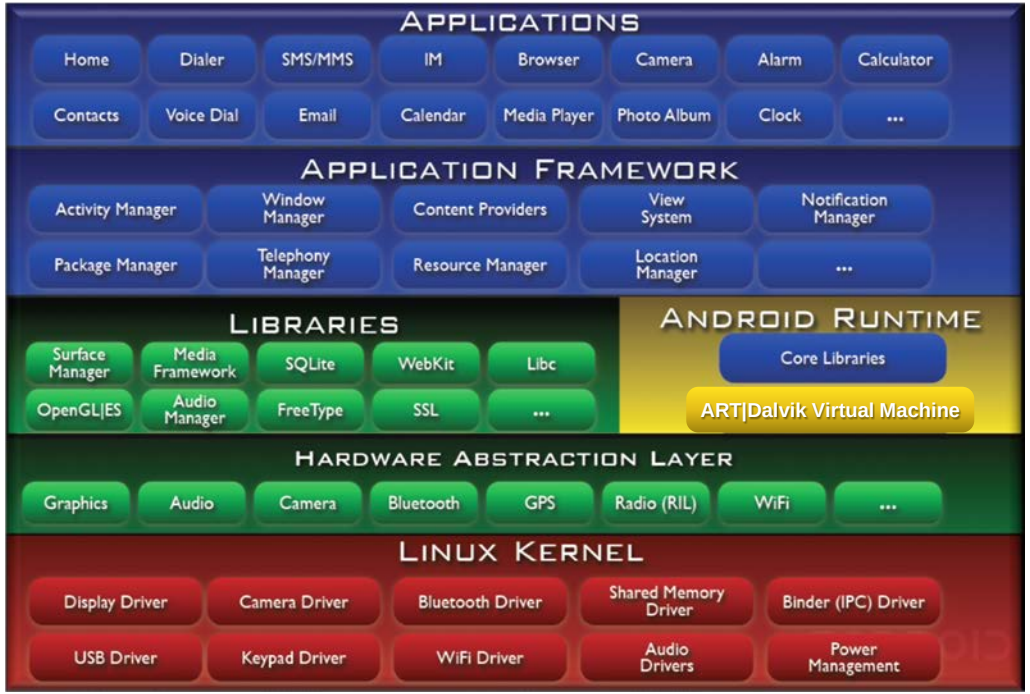



Hardware components

See en.wikipedia.org/wiki/Transceiver

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors
  - Transceivers, e.g.
    - WiFi
      - Provides a wireless local area network



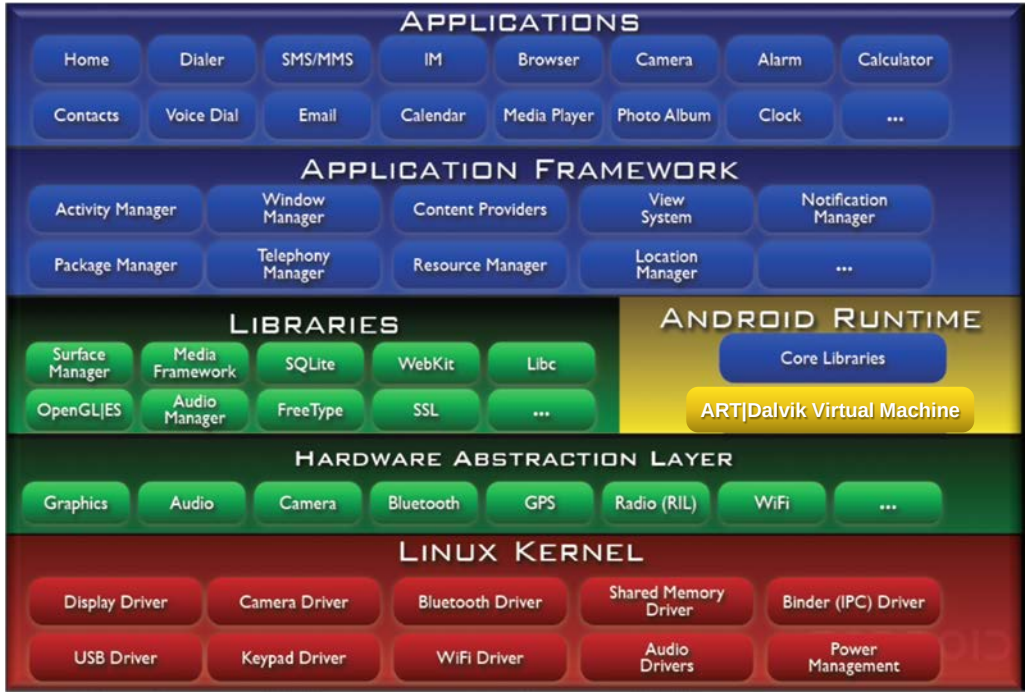



Hardware components

See en.wikipedia.org/wiki/Wi-Fi

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors
  - Transceivers, e.g.
    - WiFi
    - Bluetooth
      - Exchange data over short distances in a “personal area network”

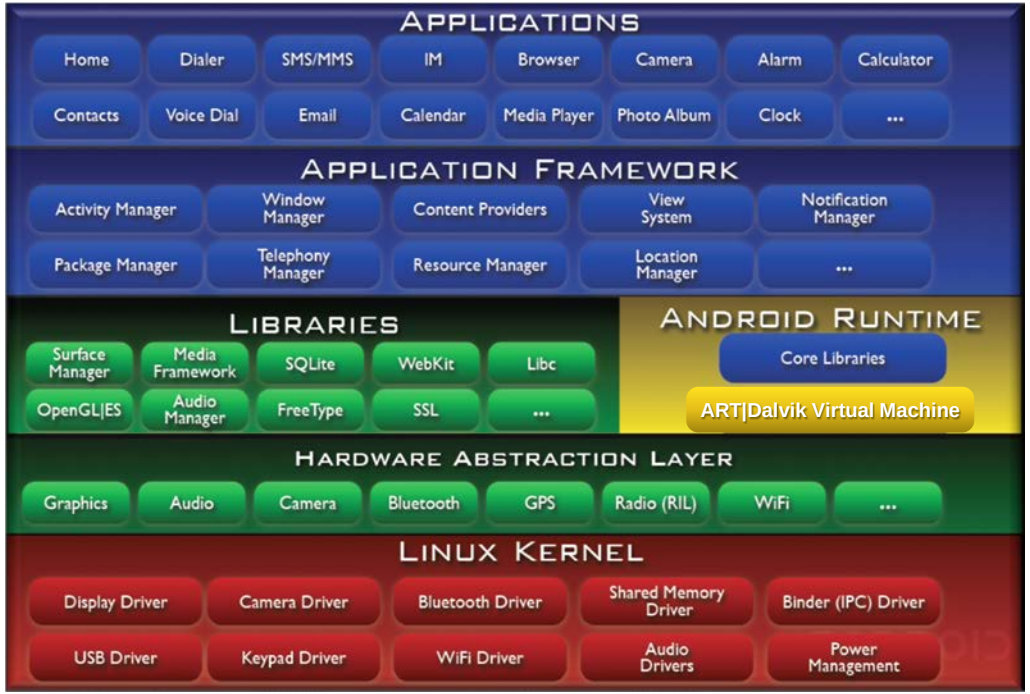


Hardware components

See en.wikipedia.org/wiki/Bluetooth

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors
  - Transceivers, e.g.
    - WiFi
    - Bluetooth
    - Near-field communication (NFC)
      - Enable 2 electronic devices to communicate by placing them within 2 inches



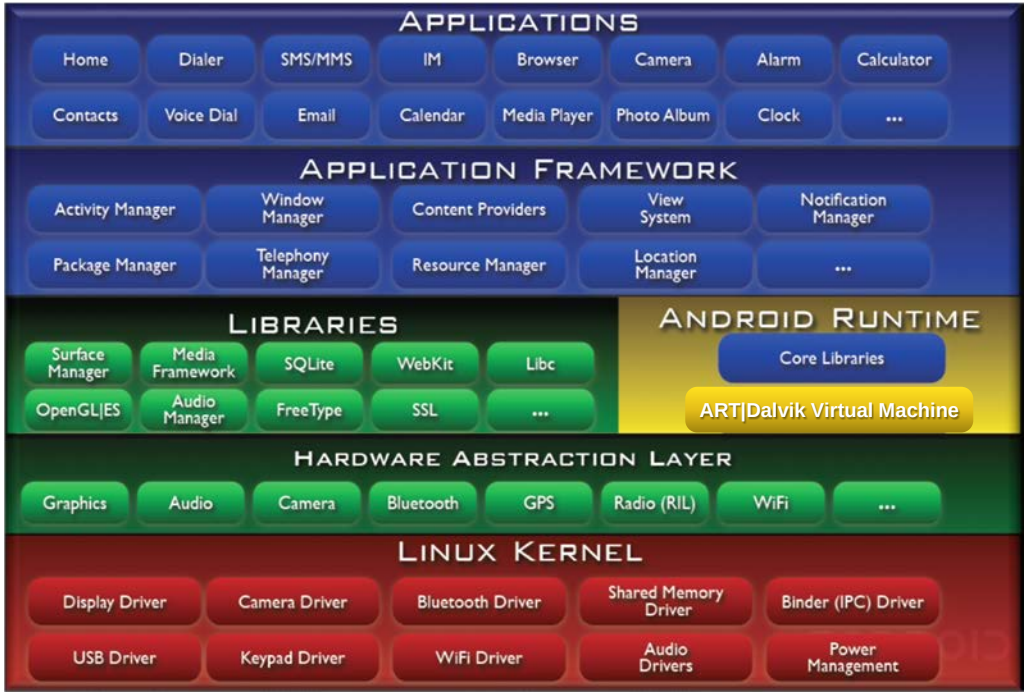
Hardware components

See en.wikipedia.org/wiki/Near_field_communication

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors
  - Transceivers
  - Storage

Storage is used to retain digital data

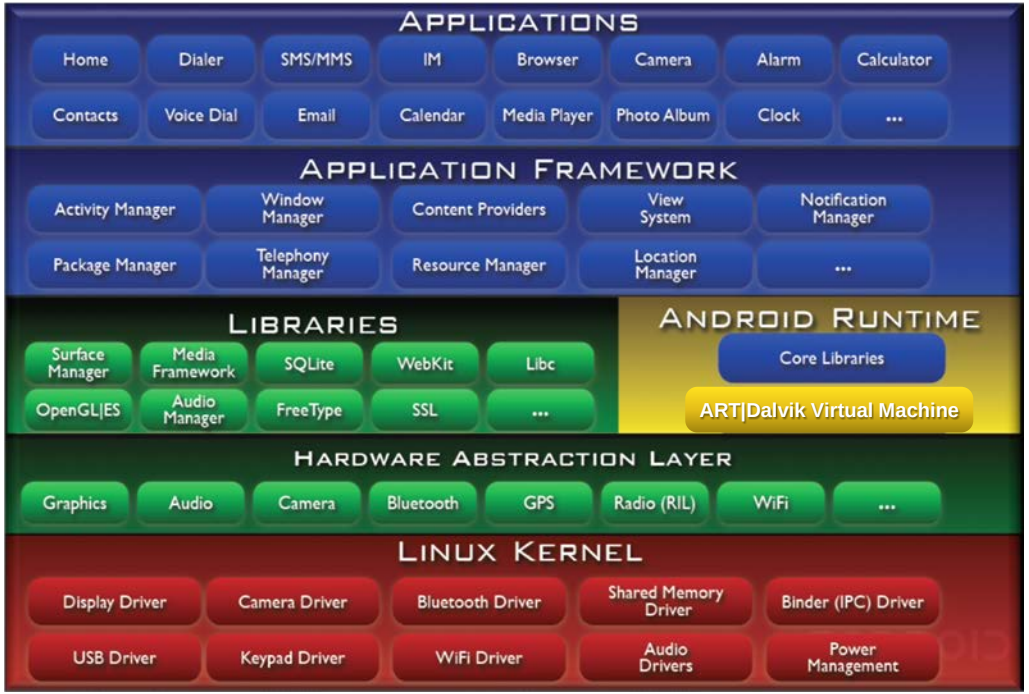


Hardware components

See en.wikipedia.org/wiki/Computer_data_storage

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors
  - Transceivers
  - Storage, e.g.
    - Random access memory (RAM)
      - Allows read/write access to data in ~same amount of time irrespective of location

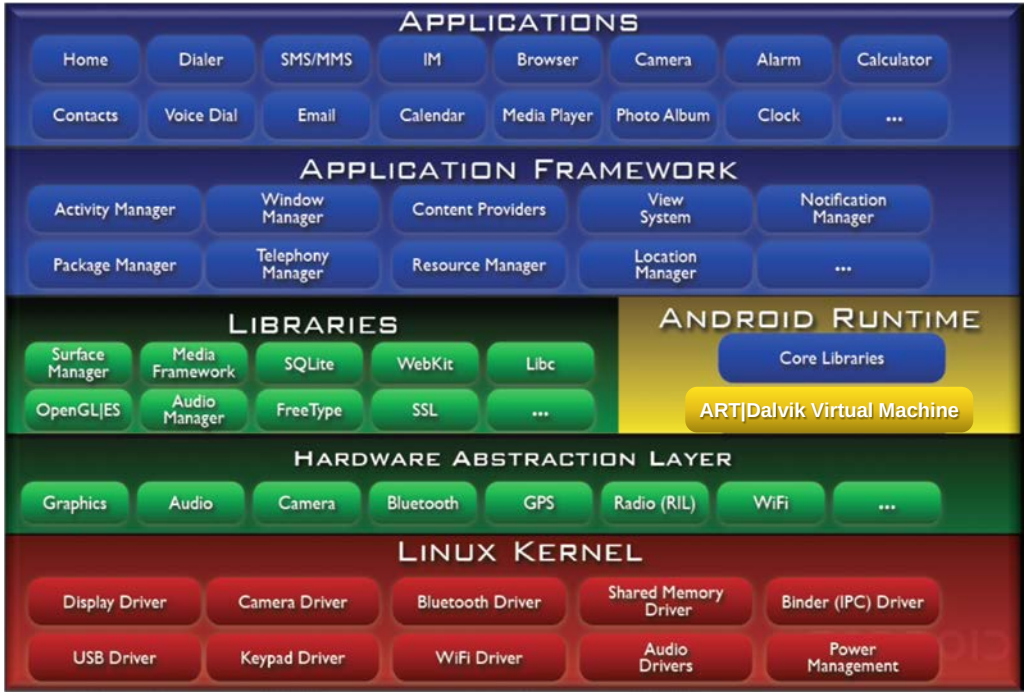


Hardware components

See en.wikipedia.org/wiki/Random-access_memory

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors
  - Transceivers
  - Storage, e.g.
    - Random access memory (RAM)
    - Flash memory
      - Non-volatile memory that can be electrically erased & reprogrammed

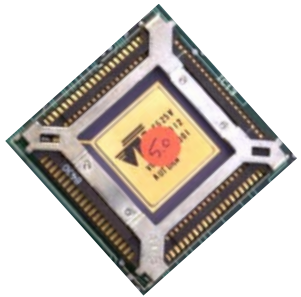


Hardware components

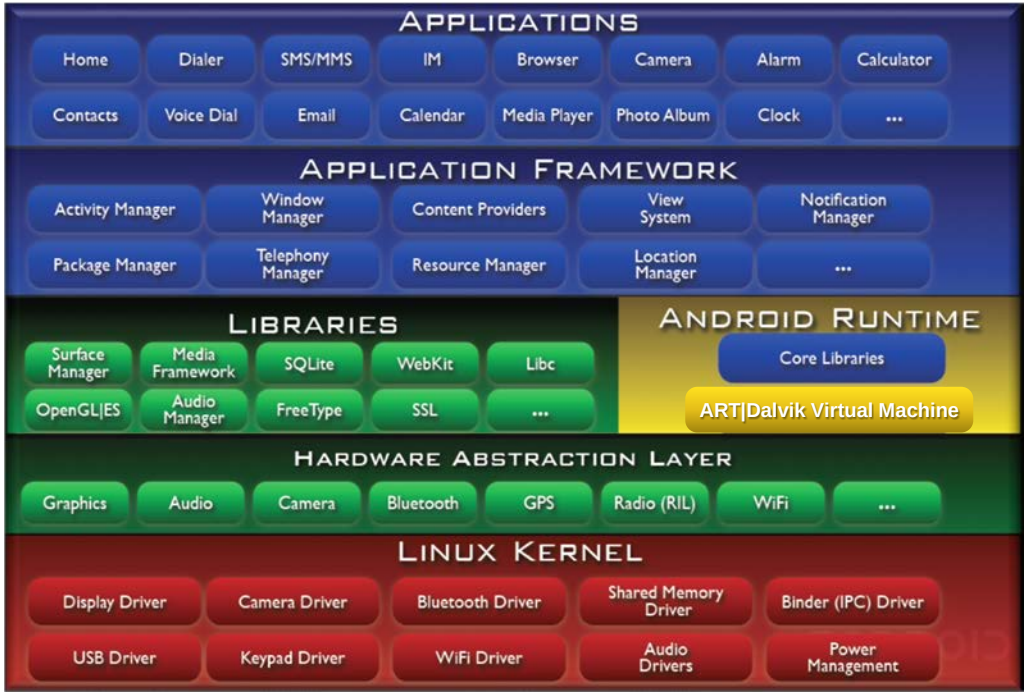
See en.wikipedia.org/wiki/Flash_memory

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors
  - Transceivers
  - Storage
  - Processors



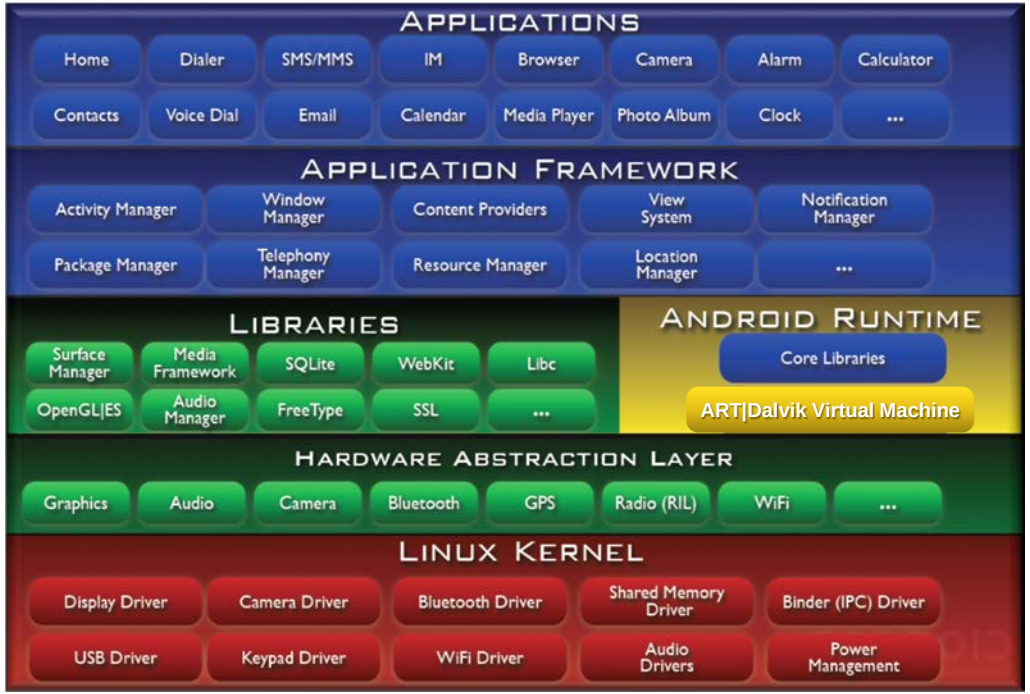
Processors perform instructions of computer programs



Hardware components

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors
  - Transceivers
  - Storage
  - Processors, e.g.,
    - Central processing units
      - Performs basic arithmetic, logical, control, & I/O operations

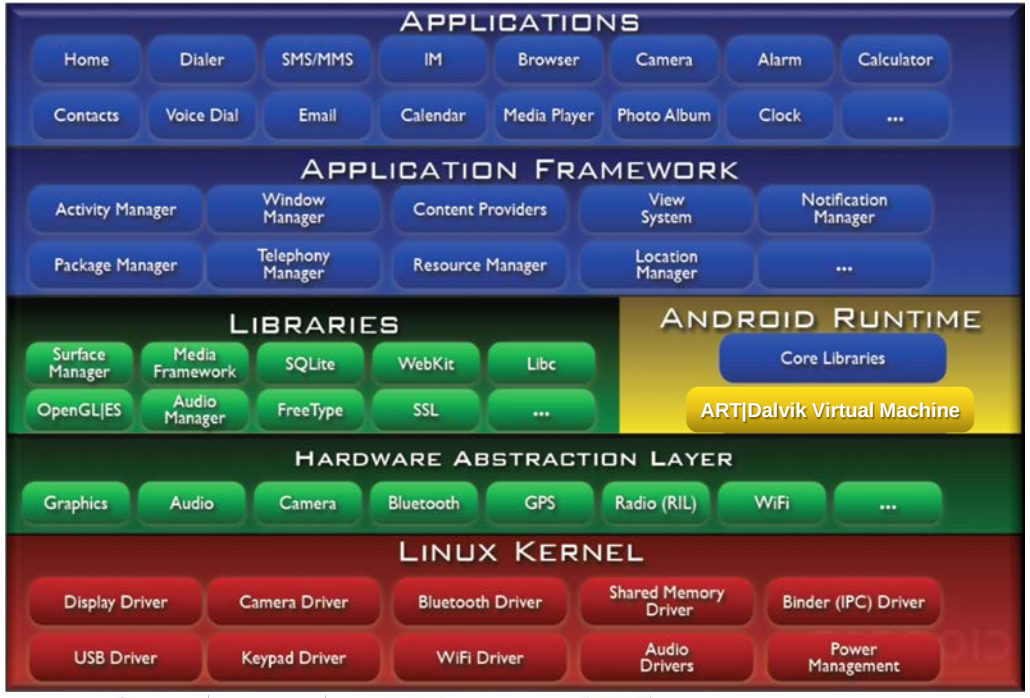


Hardware components

See en.wikipedia.org/wiki/Central_processing_unit

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors
  - Transceivers
  - Storage
  - Processors, e.g.,
    - Central processing units
      - Performs basic arithmetic, logical, control, & I/O operations
      - Increasingly multi-core

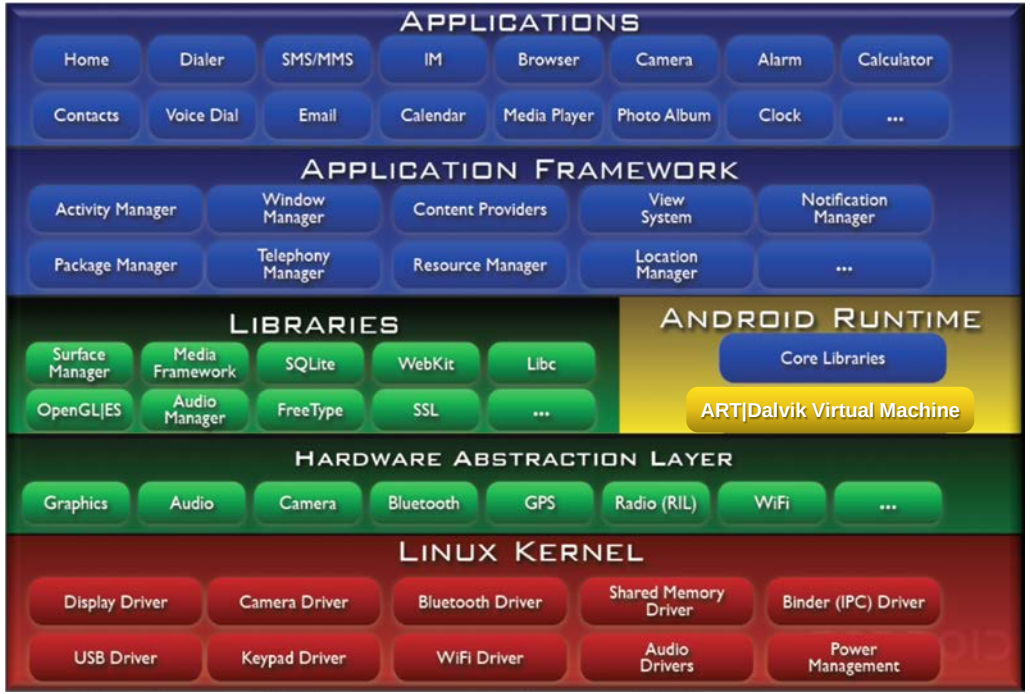


Hardware components

See www.androidauthority.com/fact-or-fiction-android-apps-only-use-one-cpu-core-610352

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors
  - Transceivers
  - Storage
  - Processors, e.g.,
    - Central processing units
    - Graphics processing units
      - More efficient than CPUs for processing of large blocks of data in parallel

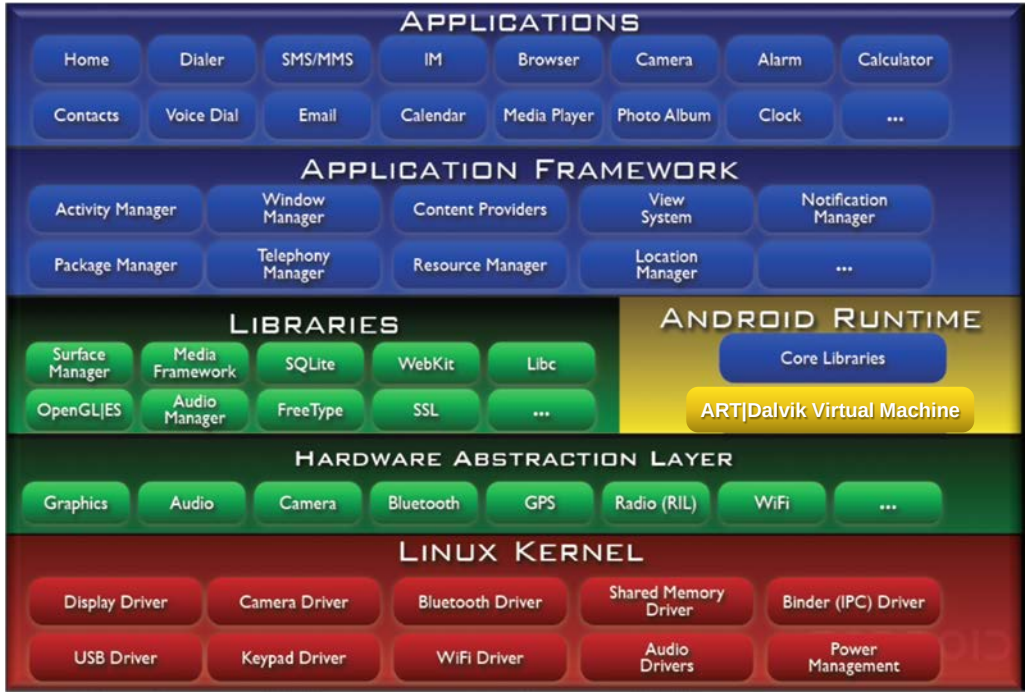


Hardware components

See en.wikipedia.org/wiki/Graphics_processing_unit

Overview of Android Layers: Hardware

- Android devices are built upon a range of hardware elements, e.g.
  - Sensors
  - Transceivers
  - Storage
  - Processors, e.g.,
    - Central processing units
    - Graphics processing units
    - Digital signal processors
      - Efficiently measure, filter & compress continuous analog signals



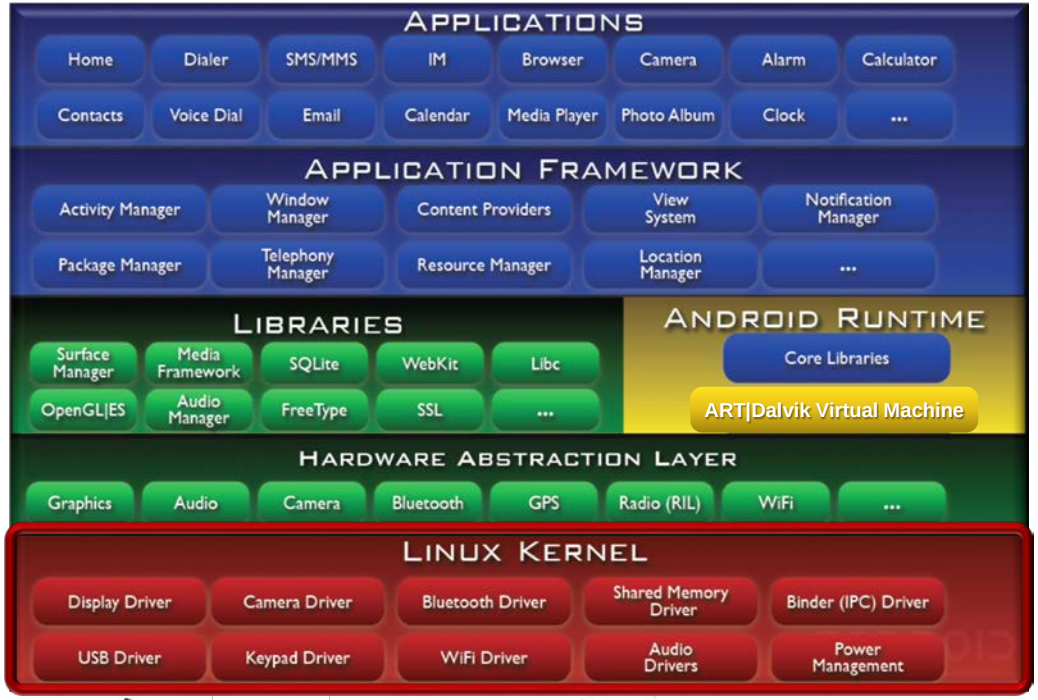
Hardware components

See en.wikipedia.org/wiki/Digital_signal_processor

Overview of the Android Linux Kernel

Overview of Android Layers: Android Linux Kernel

- Android Linux is a variant of the GNU Linux operating system (OS) kernel



Hardware components

See en.wikipedia.org/wiki/Linux_kernel

Overview of Android Layers: Android Linux Kernel

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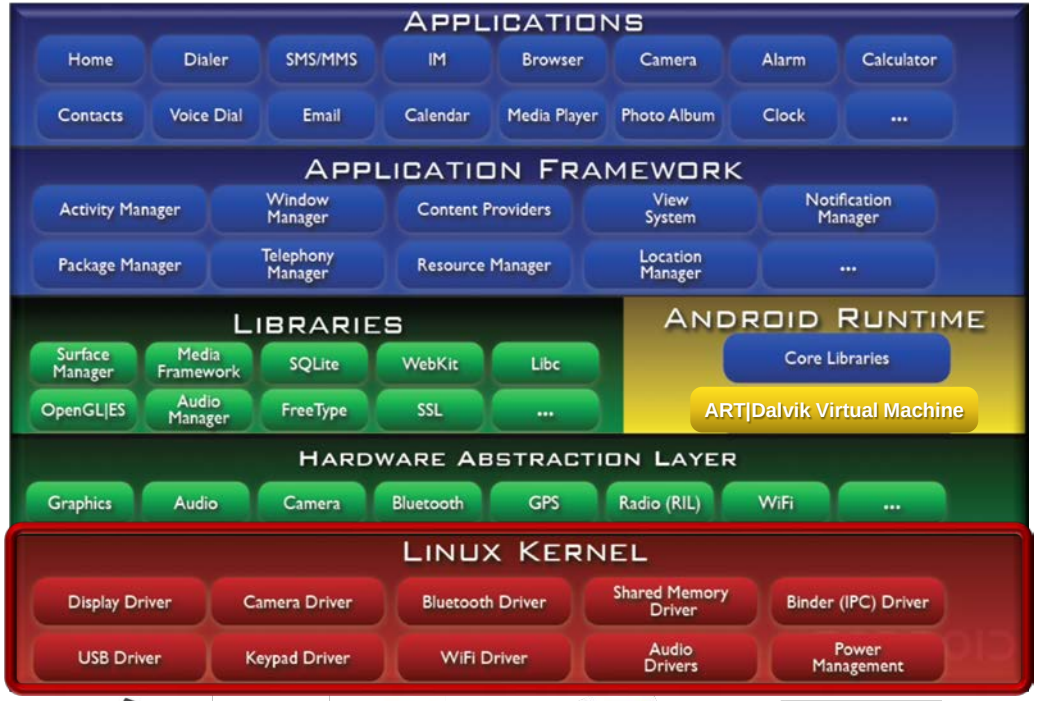


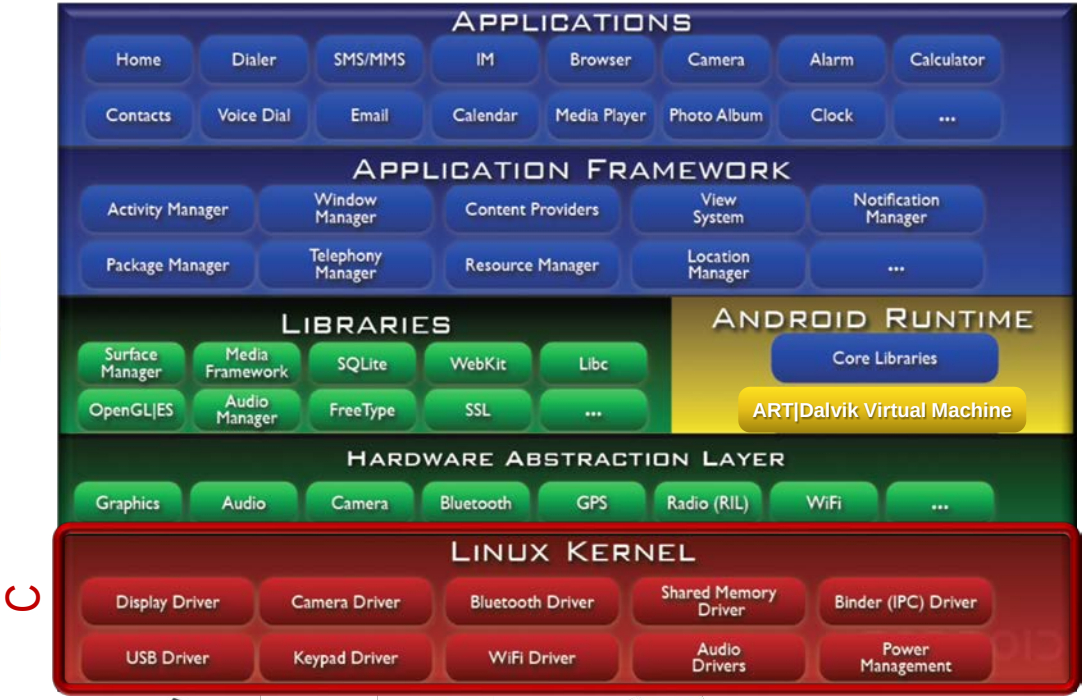
Android Linux kernel is written in C & ships separately from rest of Android stack

Hardware components

See source.android.com/source/building-kernels.html#downloading-sources

Overview of Android Layers: Android Linux Kernel

- Android Linux is a variant of the GNU Linux operating system (OS) kernel
  - Optimized to meet the needs of mobile devices & apps

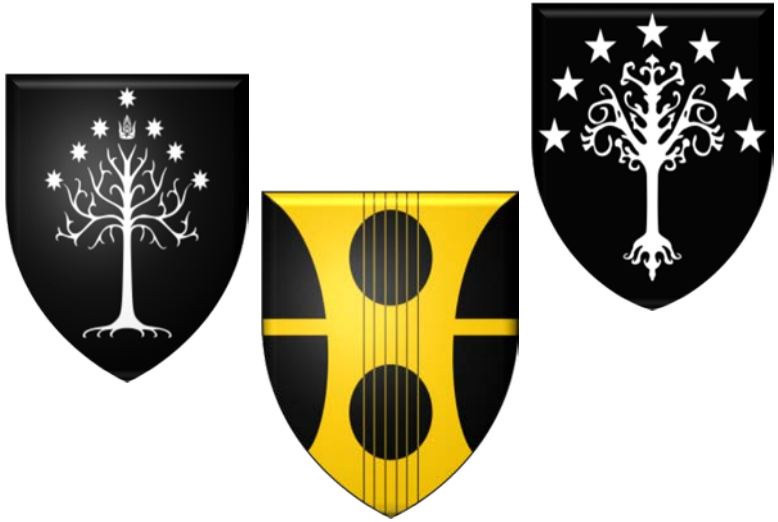


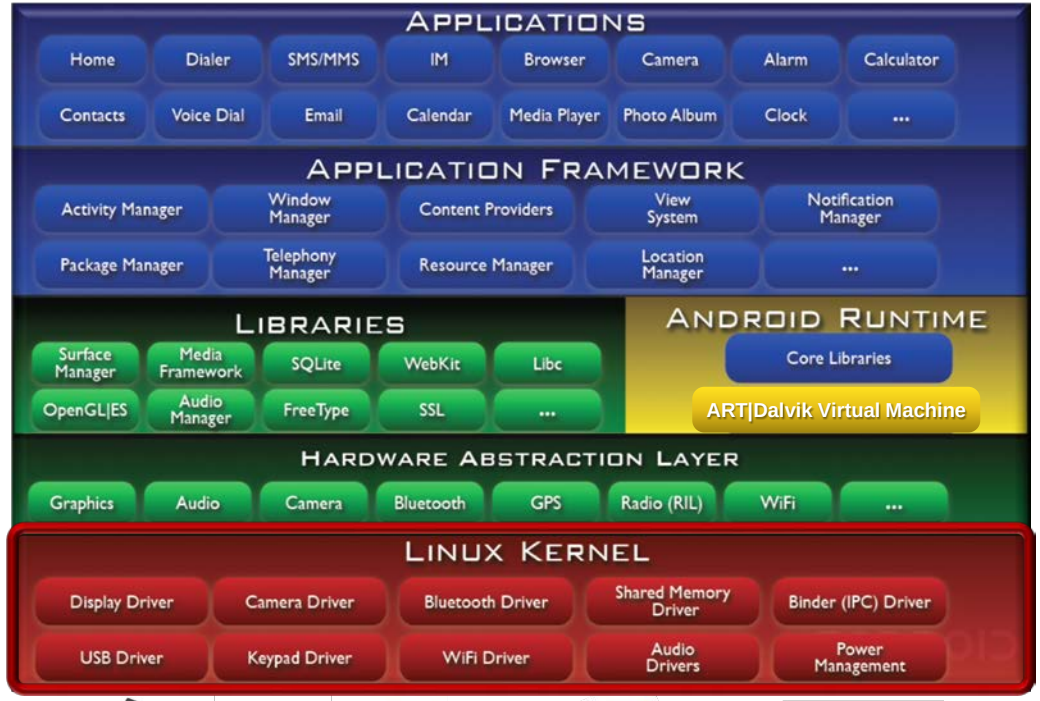
Hardware components

See en.wikipedia.org/wiki/Android_(operating_system)#Linux_kernel

Overview of Android Layers: Android Linux Kernel

- Android Linux is a variant of the GNU Linux operating system (OS) kernel
  - Optimized to meet the needs of mobile devices & apps
  - Shields higher Android layers from hardware diversity





Hardware components

See en.wikipedia.org/wiki/List_of_Linux-supported_computer_architectures

Overview of Android Layers: Android Linux Kernel

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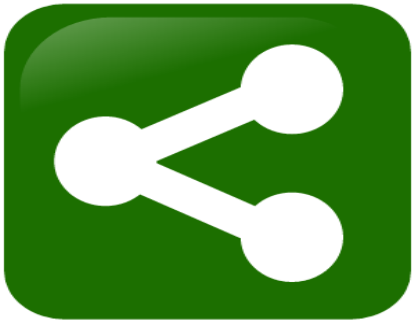
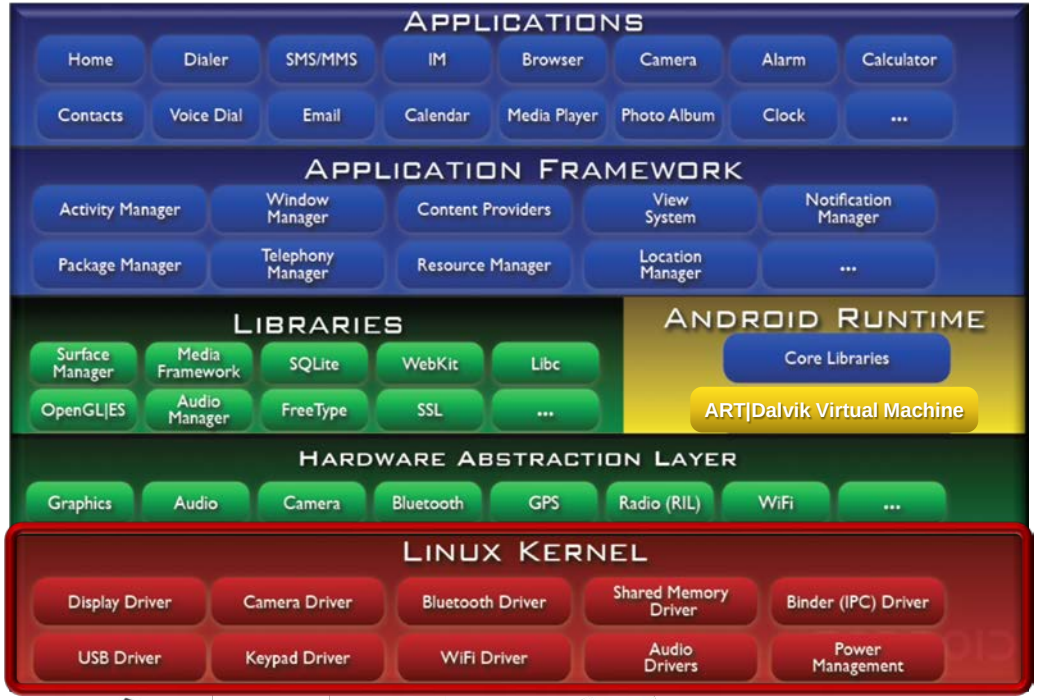
  - Mediates access to—& sharing of—hardware resources





Hardware components

See en.wikipedia.org/wiki/Kernel_(operating_system)#Functions_of_the_kernel

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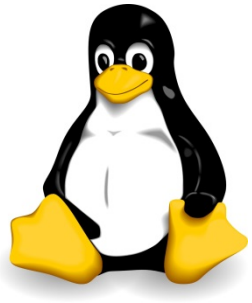
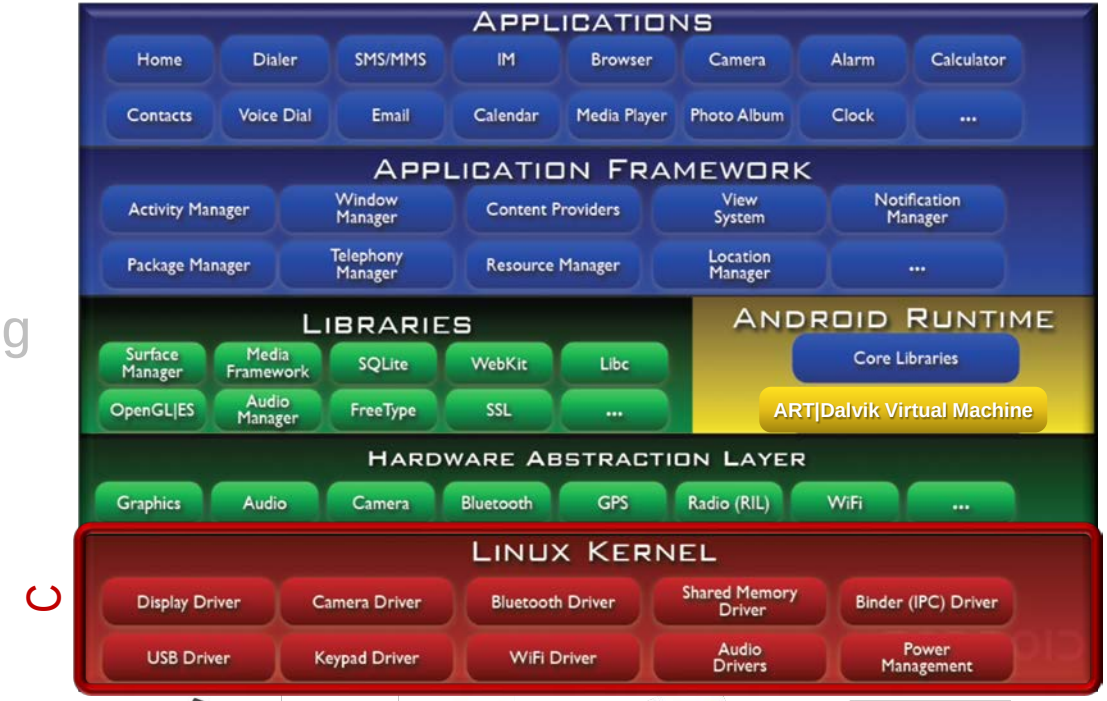
  - Mediates access to—& sharing of—hardware resources
  - Extends GNU Linux





Hardware components

See elinux.org/Android_Kernel_Features

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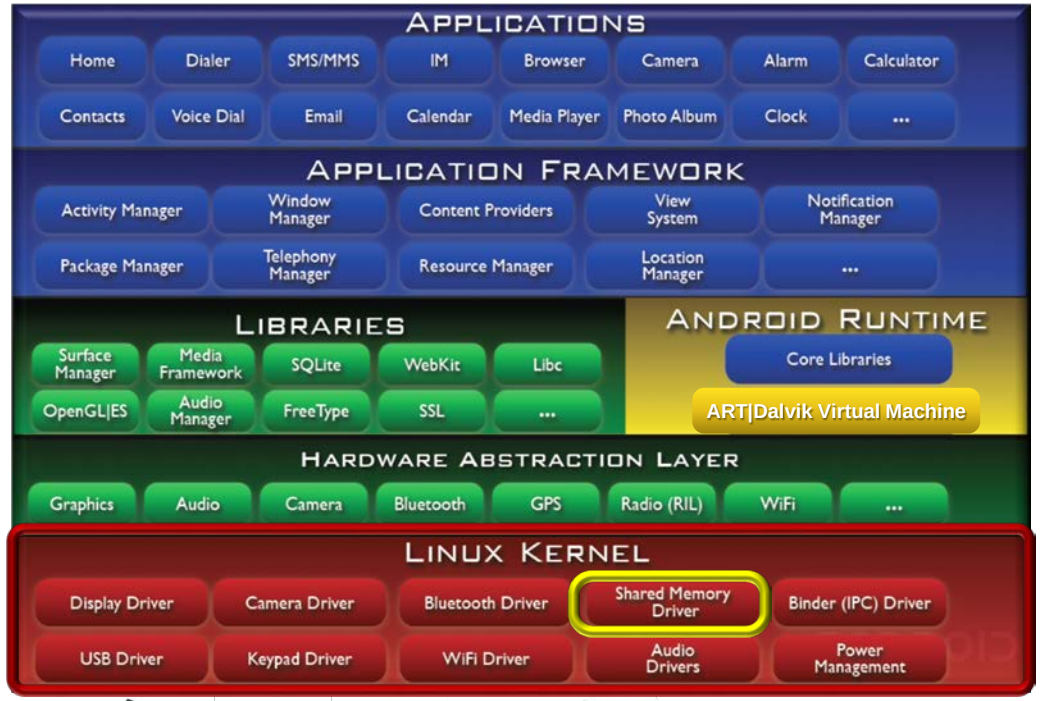
  - Mediates access to—& sharing of—hardware resources
  - Extends GNU Linux, e.g.
    - conserve memory



Hardware components

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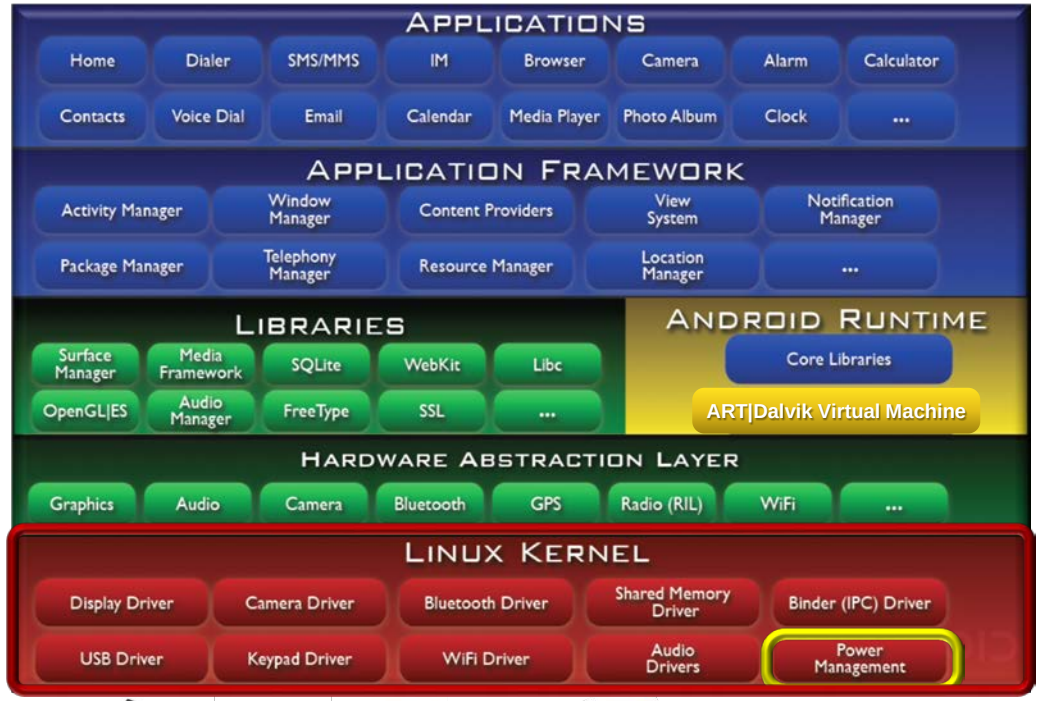
  - Extends GNU Linux, e.g.
    - conserve memory
    - manage power



Hardware components

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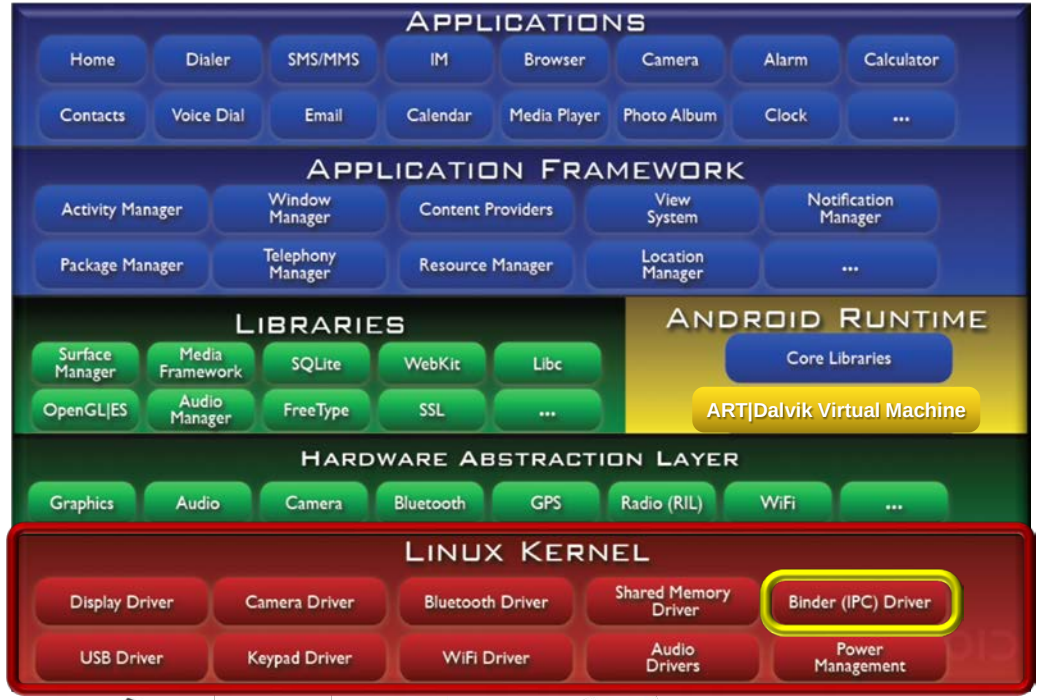
    - conserve memory
    - manage power
    - accelerate communication



Hardware components

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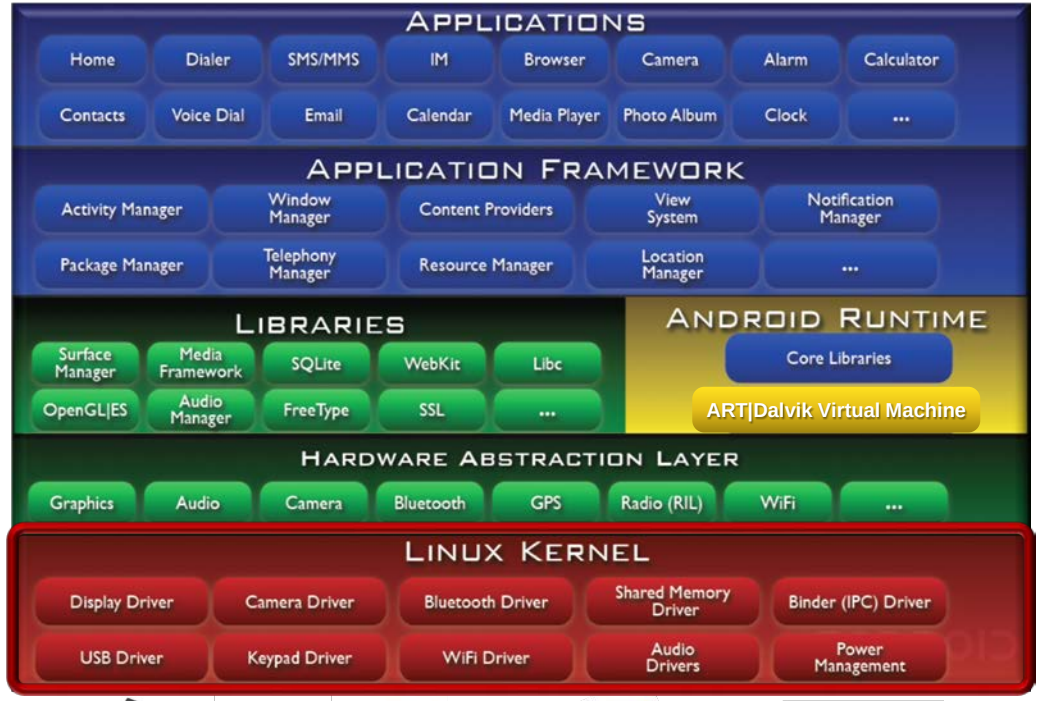

Hardware components

See elinux.org/Android_Mainlining_Project

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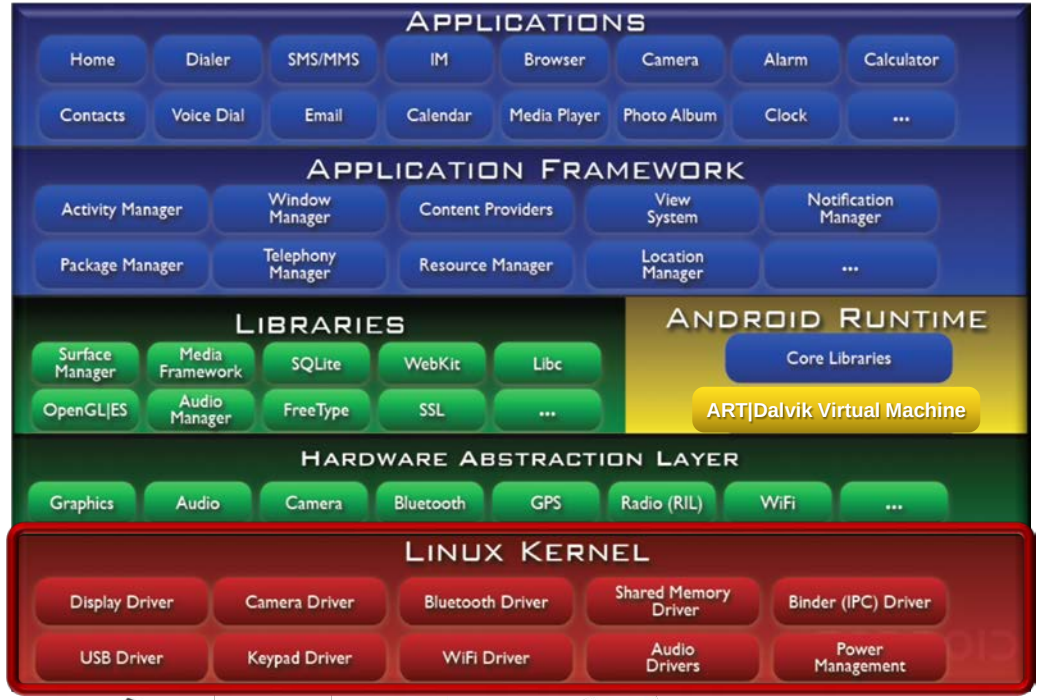

Hardware components

Overview of Android Layers: Android Linux Kernel

- The Android Linux kernel is a forked version of the GNU Linux kernel

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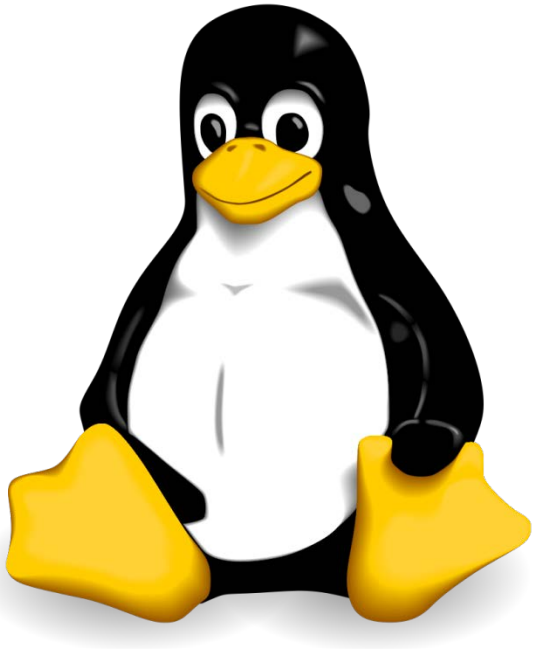

See en.wikipedia.org/wiki/Fork_(software_development)

Overview of Android Layers: Android Linux Kernel

- The Android Linux kernel is a forked version of the GNU Linux kernel
  - It therefore isn't entirely compatible with the GNU Linux kernel

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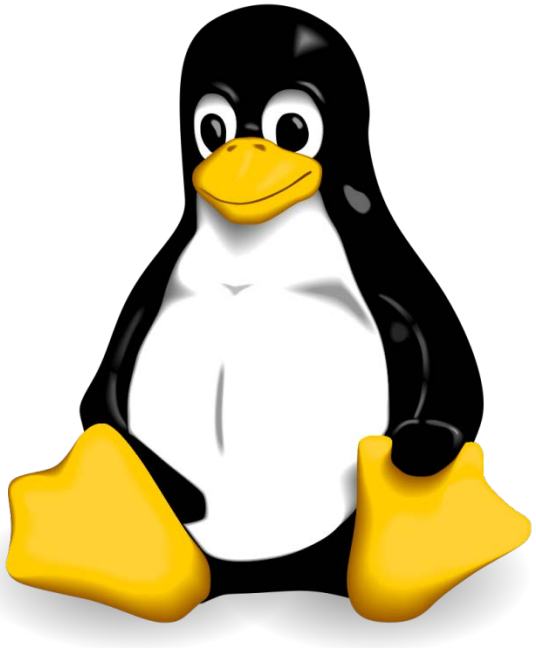

However, Android Linux kernel offers familiar/robust capabilities for mobile apps

End of the Overview of Android (Part 1): Hardware & OS Kernel