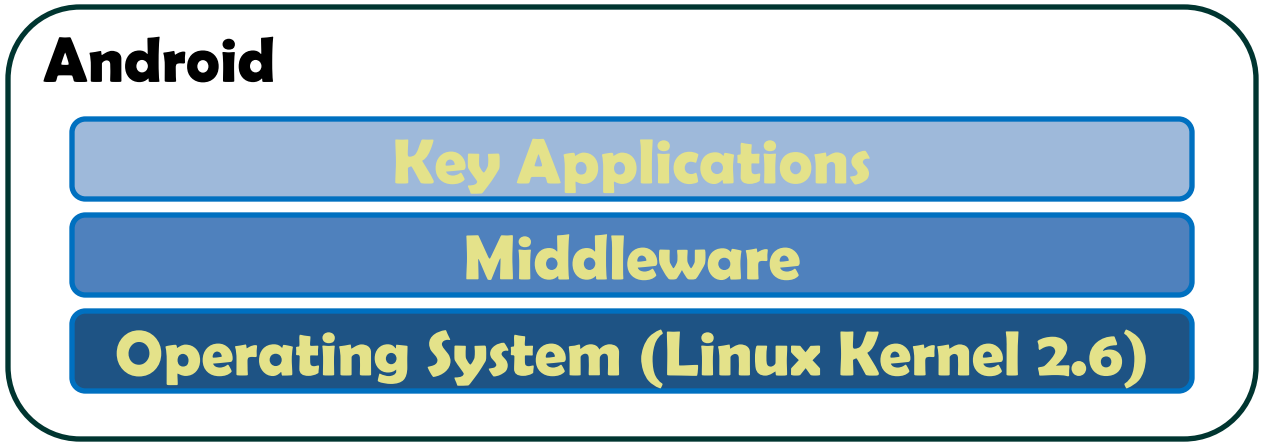
Android Platform Overview

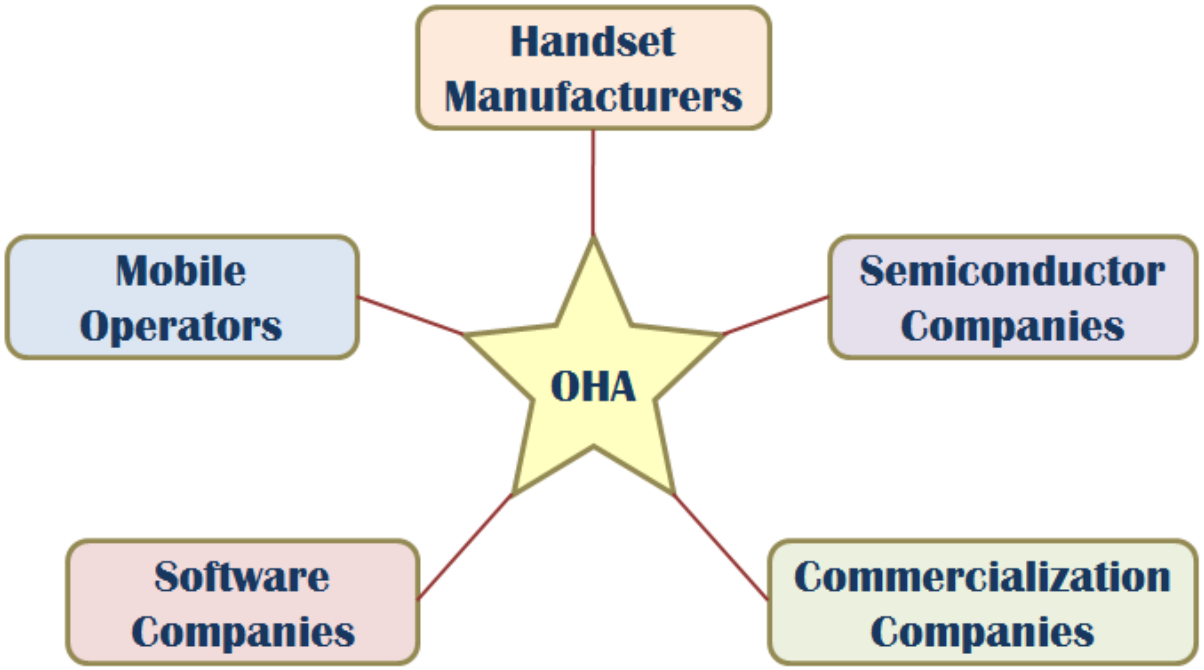
Android

- A S/W stack for mobile devices developed and managed by OHA
- A free S/W under Apache License

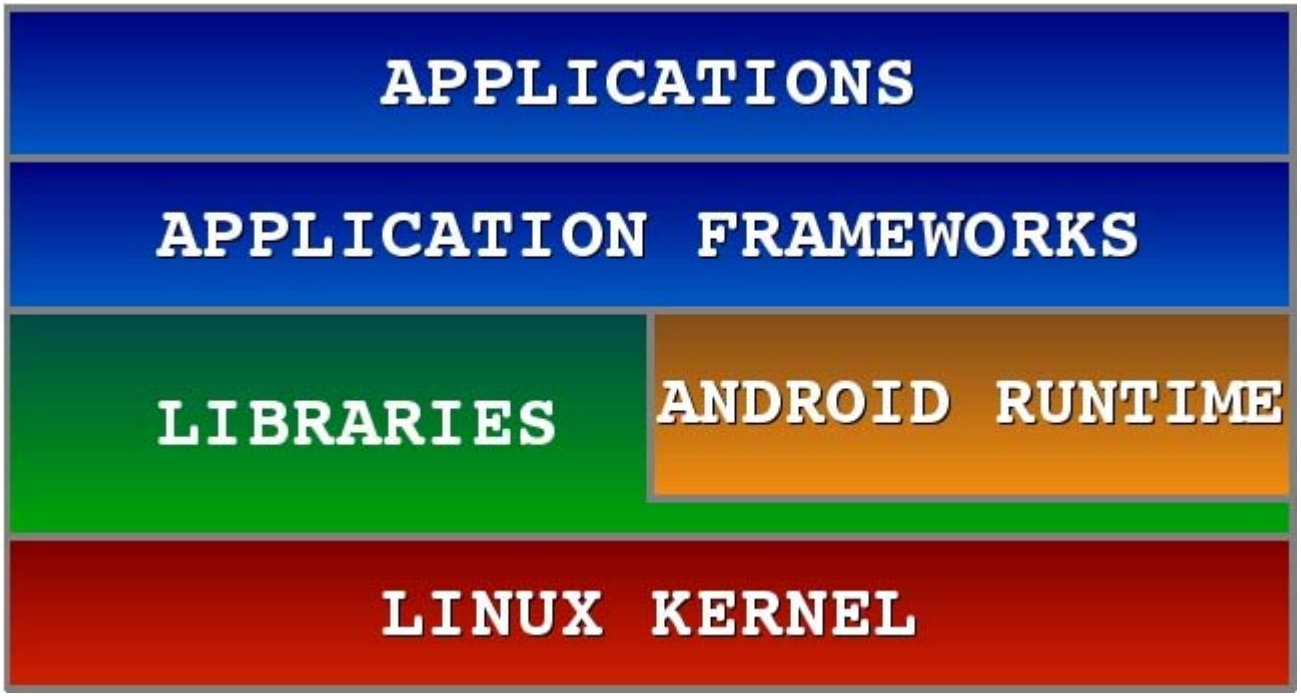


OHA (Open Handset Alliance)

- A business alliance consisting of 47 companies to develop open standards for mobile devices



Android Software Stack



Android S/W Stack – Linux Kernel

- Relying on Linux Kernel 2.6 for core system services
  - ✓ Memory and Process Management
  - ✓ Network Stack
  - ✓ Driver Model
  - ✓ Security
- Providing an abstraction layer between the H/W and the rest of the S/W stack

Android S/W Stack – Linux Kernel (Cont)

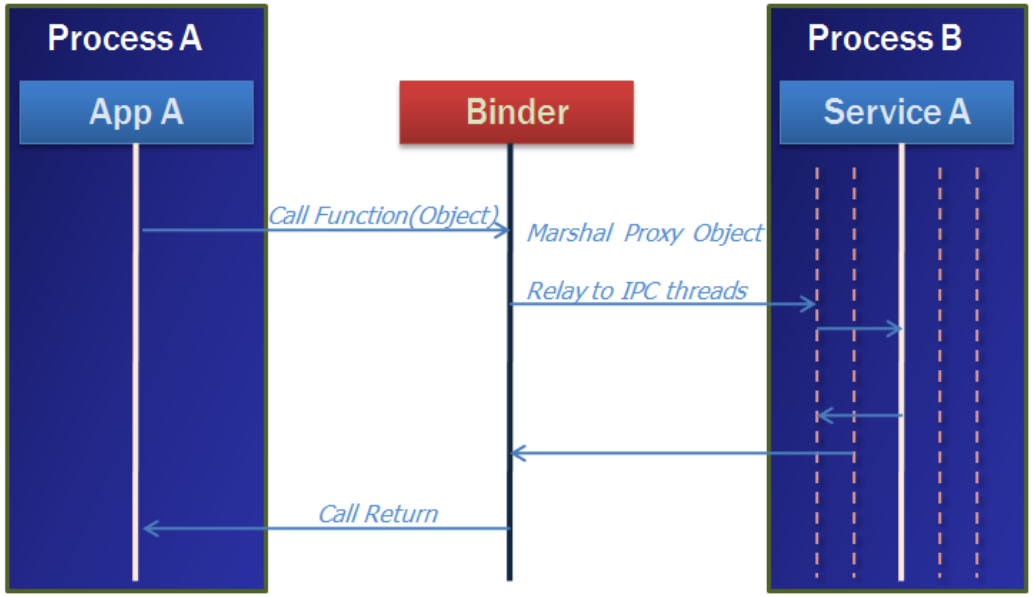
- Kernel Enhancements
  - ✓ Alarm
  - ✓ Ashmem
  - ✓ Binder
  - ✓ Power Management
  - ✓ Low Memory Killer
  - ✓ Kernel Debugger
  - ✓ Logger

Android S/W Stack – Linux Kernel (Cont)

- Binder
  - ✓ Driver to facilitate IPC between applications and services
  - ✓ Problems of Linux IPC
    - ➢ Applications and Services may run in separate processes but must communicate and share data
    - ➢ IPC can introduce significant processing overhead and security hole
  - ✓ Properties of Binder
    - ➢ High performance through shared memory
    - ➢ Per-process thread pool for processing requests
    - ➢ Reference counting and mapping of object references across processes
    - ➢ Synchronous calls between processes

Android S/W Stack – Linux Kernel (Cont)

- Binder in Action



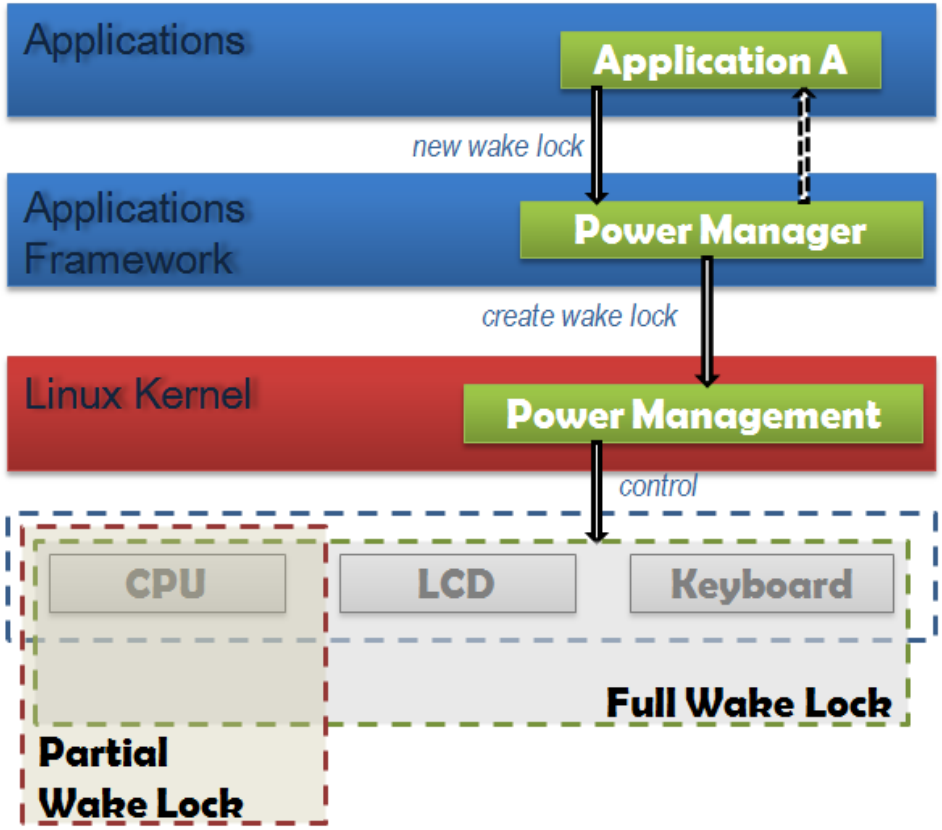
- ✓ A pool of threads is associated to each service application to process incoming IPC.
- ✓ Binder performs mapping of object between two processes.
- ✓ Binder uses an object reference as an address in a process's memory space.

Android S/W Stack – Linux Kernel (Cont)

- Power Management
  - ✓ Problem
    - ➢ Mobile devices depend on battery power and batteries have limited capacity.
  - ✓ Properties of Power Management
    - ➢ PM is built on top of standard Linux Power Management.
    - ➢ PM supports more aggressive power management policy.
    - ➢ Components make requests to keep the power on through "Wake Locks".
    - ➢ PM supports several different types of wake "Wake Locks".

Android S/W Stack – Linux Kernel (Cont)

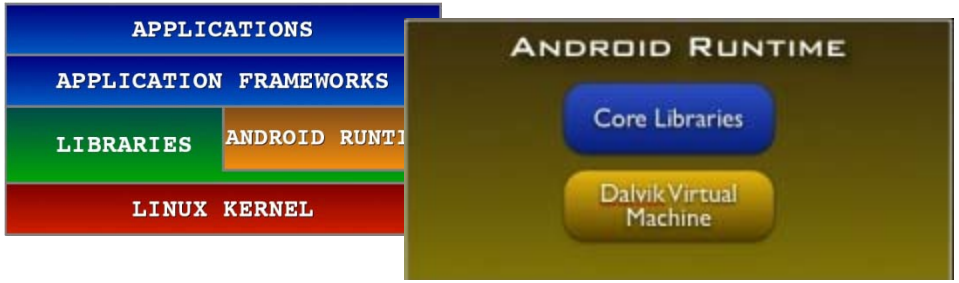
- Power Management in Action



✓If there are no active wake locks, CPU will be turned off.

✓If there are no partial wake locks, screen and keyboard will be turned off.

Android S/W Stack - Runtime



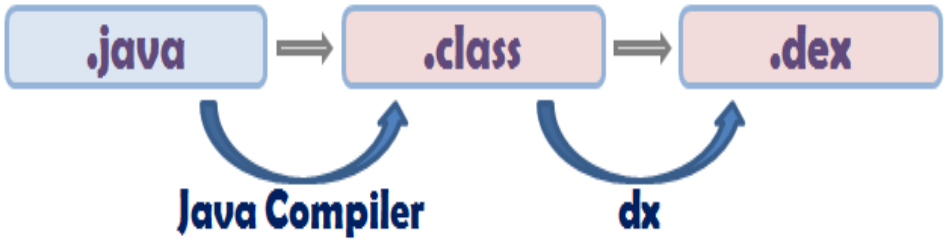
- Core Libraries
  - ✓ Providing most of the functionality available in the core libraries of the Java language
  - ✓ APIs
    - ➢ Data Structures
    - ➢ Utilities
    - ➢ File Access
    - ➢ Network Access
    - ➢ Graphics
    - ➢ Etc

Android S/W Stack – Runtime (Cont)

- Dalvik Virtual Machine
  - ✓ Providing environment on which every Android application runs
    - ➢ Each Android application runs in its own process, with its own instance of the Dalvik VM.
    - ➢ Dalvik has been written so that a device can run multiple VMs efficiently.
  - ✓ Register-based virtual machine

Android S/W Stack – Runtime (Cont)

- Dalvik Virtual Machine (Cont)
  - ✓ Executing the Dalvik Executable (.dex) format
    - ➢ .dex format is optimized for minimal memory footprint.
    - ➢ Compilation



  - ✓ Relying on the Linux Kernel for:
    - ➢ Threading
    - ➢ Low-level memory management

Android S/W Stack - Libraries

- Including a set of C/C++ libraries used by components of the Android system
- Exposed to developers through the Android application framework

Android S/W Stack – Libraries (Cont)

- Features
  - ✓ System C Library (Bionic)
  - ✓ Media Libraries
  - ✓ Surface Manager (Surface Flinger)
  - ✓ Audio Manager (Audio Flinger)
  - ✓ LibWebCore (WebKit)
  - ✓ SGL
  - ✓ 3D Libraries
  - ✓ FreeType
  - ✓ SQLite

Android S/W Stack – Libraries (Cont)

- Bionic
  - ✓ Custom libc implementation optimized for embedded use
  - ✓ Problem with GNU libc

License	The authors want to keep GPL out of user-space.
Size	Libc will load in each process, so it needs to be small.
Speed	Limited CPU power means it needs to be fast.

Android S/W Stack – Libraries (Cont)

- Bionic (Cont)
  - ✓ Properties
    - ➢ BSD license
    - ➢ Small size and fast code paths
    - ➢ Very fast and small custom pthread implementation
    - ➢ No support for certain POSIX features
    - ➢ No compatibility with GNU libc
    - ➢ Constraint that all native code must be compiled against bionic

Android S/W Stack – Libraries (Cont)

- WebKit
  - ✓ An application framework that provides foundation for building a web browser based on open source WebKit browser
  - ✓ Properties
    - ➢ Ability to render pages in full (desktop) view
    - ➢ Full CSS, JavaScript, DOM, AJAX support
    - ➢ Support for single-column and adaptive view rendering

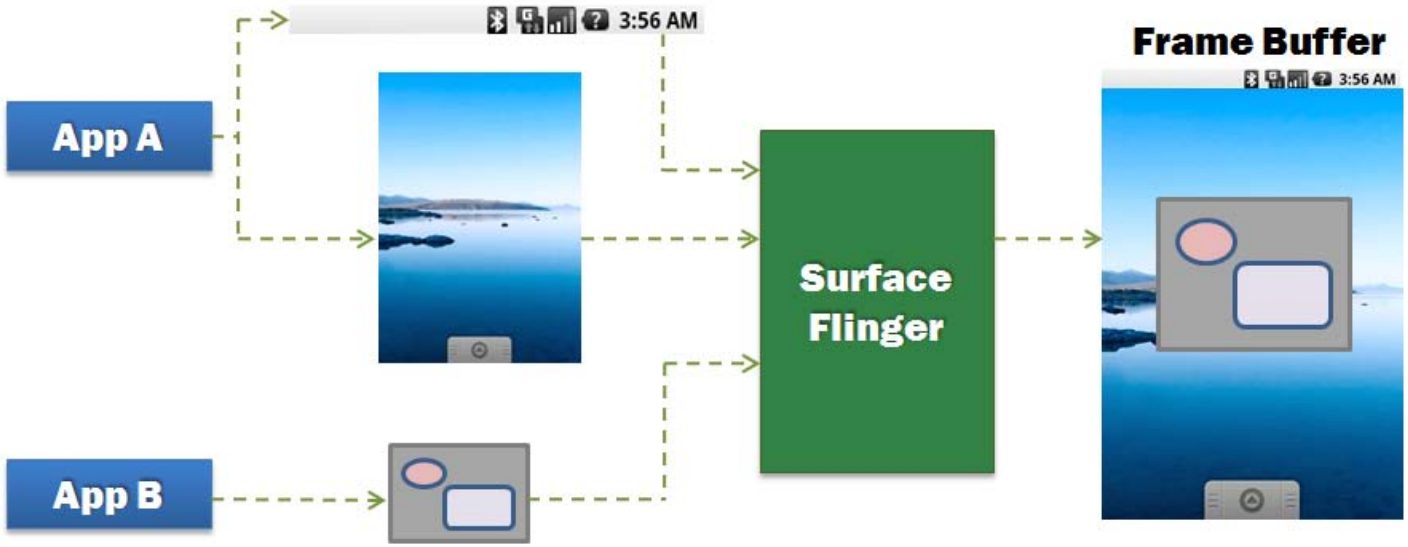
Android S/W Stack – Libraries (Cont)

- Media Framework
  - ✓ A media framework based on PacketVideo OpenCore platform
  - ✓ Properties
    - ➢ Support for standard video, audio, still-frame formats
    - ➢ Support for hardware/software codec plug-ins

- SQLite
  - ✓ Light-weight relational database management system
  - ✓ Back end for most platform data storgae

Android S/W Stack – Libraries (Cont)

- Surface Manager (Surface Flinger)
  - ✓ Providing system-wide surface composer, handling all surface rendering to frame buffer device
  - ✓ Operation



Android S/W Stack – Libraries (Cont)

- Surface Manager (Cont)
  - ✓ Properties
    - ➢ Can combine 2D and 3D surfaces and surfaces from multiple applications
    - ➢ Surfaces passed as buffers via Binder IPC calls
    - ➢ Can use OpenGL ES and 2D hardware accelerator for its compositions
    - ➢ Double-buffering using page-flip

Android S/W Stack – Libraries (Cont)

- Audio Manager (Audio Flinger)
  - ✓ Processing multiple audio streams into PCM audio out paths
  - ✓ Operation

Android S/W Stack – Libraries (Cont)

- SGL
  - ✓ The underlying 2D graphics engine
  - ✓ SGL(Skia Graphics Library)一个向量图形引擎，能在低端设备比如手机、电视及其它手持设备之上，呈现高品质的2D图形
  - ✓ Skia实际是美国Skia公司,2005年十一月被Google收购,该公司的业务是向量绘图软件.
- 3D Libraries
  - ✓ An implementation based on OpenGL ES 1.0 APIs
  - ✓ Using either H/W 3D acceleration (if available) or the included optimized 3D S/W rasterizer
- FreeType
  - ✓ Rendering bitmap and vector font

Android S/W Stack – App Framework

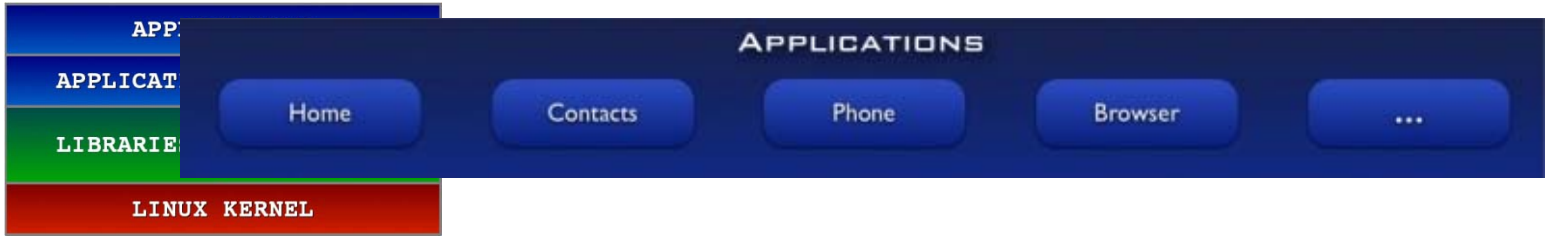
- Enabling and simplifying the reuse of components
  - ✓ Developers have full access to the same framework APIs used by the core applications.
  - ✓ Users are allowed to replace components.

Android S/W Stack – App Framework (Cont)

- Features

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 string , 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 S/W Stack - Application



- Android provides a set of core applications:
  - ✓ Email Client
  - ✓ SMS Program
  - ✓ Calendar
  - ✓ Maps
  - ✓ Browser
  - ✓ Contacts
  - ✓ Etc

- All applications are written using the Java language.