Android Architecture

Alexandra Harrison & Jake Saxton

Overview

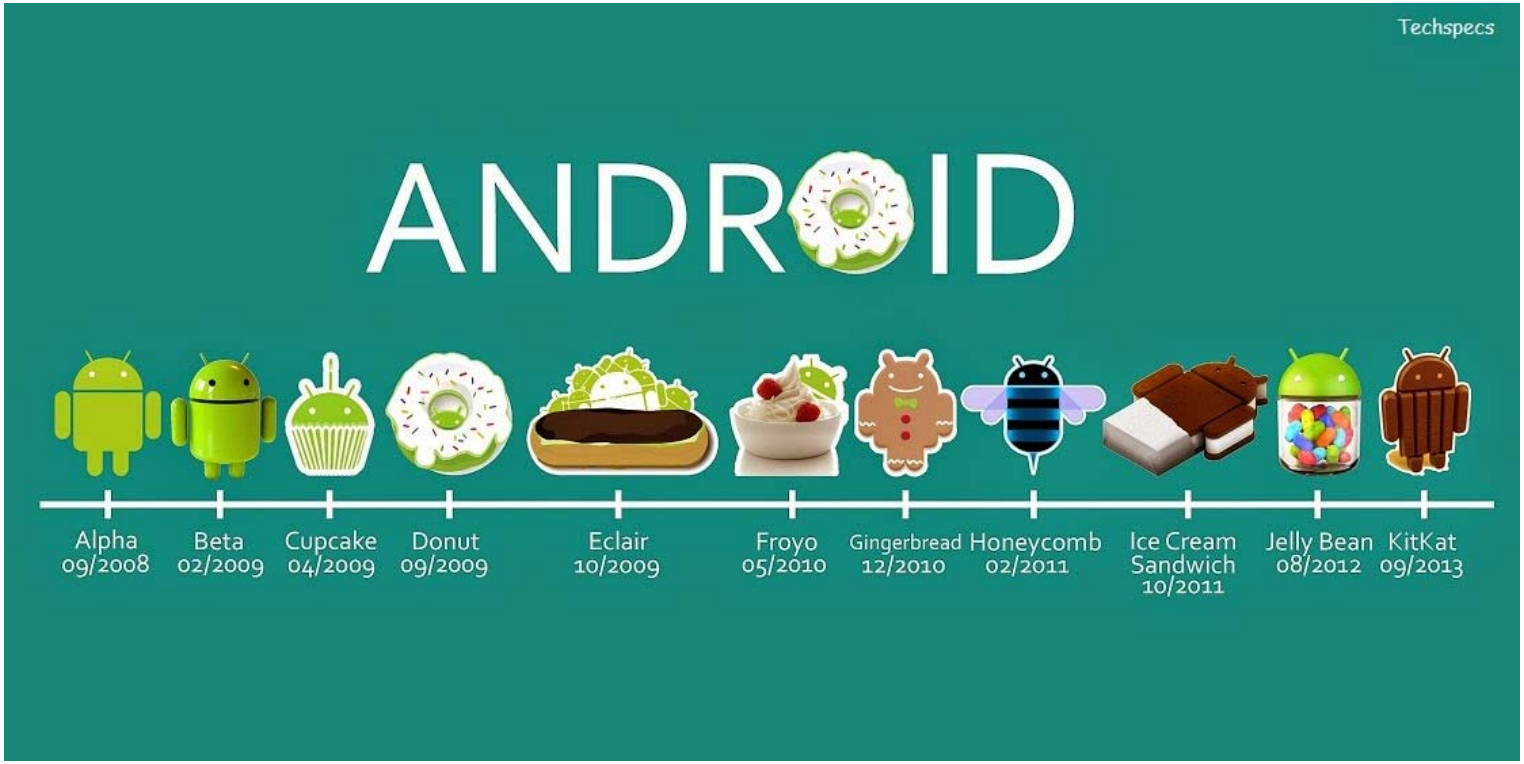
- History of Android Architecture
- Five Layers
  - Linux Kernel
  - Android Runtime
  - Libraries
  - Application Framework
  - Applications
- Summary

History

- 2003 –Founded
  - No product for two years, funded by Andy Rubin
    - Planned the next generation of smartphones
    - **Open source** evolution of “Danger”
- 2005 – Purchased by Google
  - Sooner or G1?
- 2007 – Publically announced
- 2008 – Sold first phone

G1

Previous Versions



Lollipop
09/2014

Marshmallow
09/2014

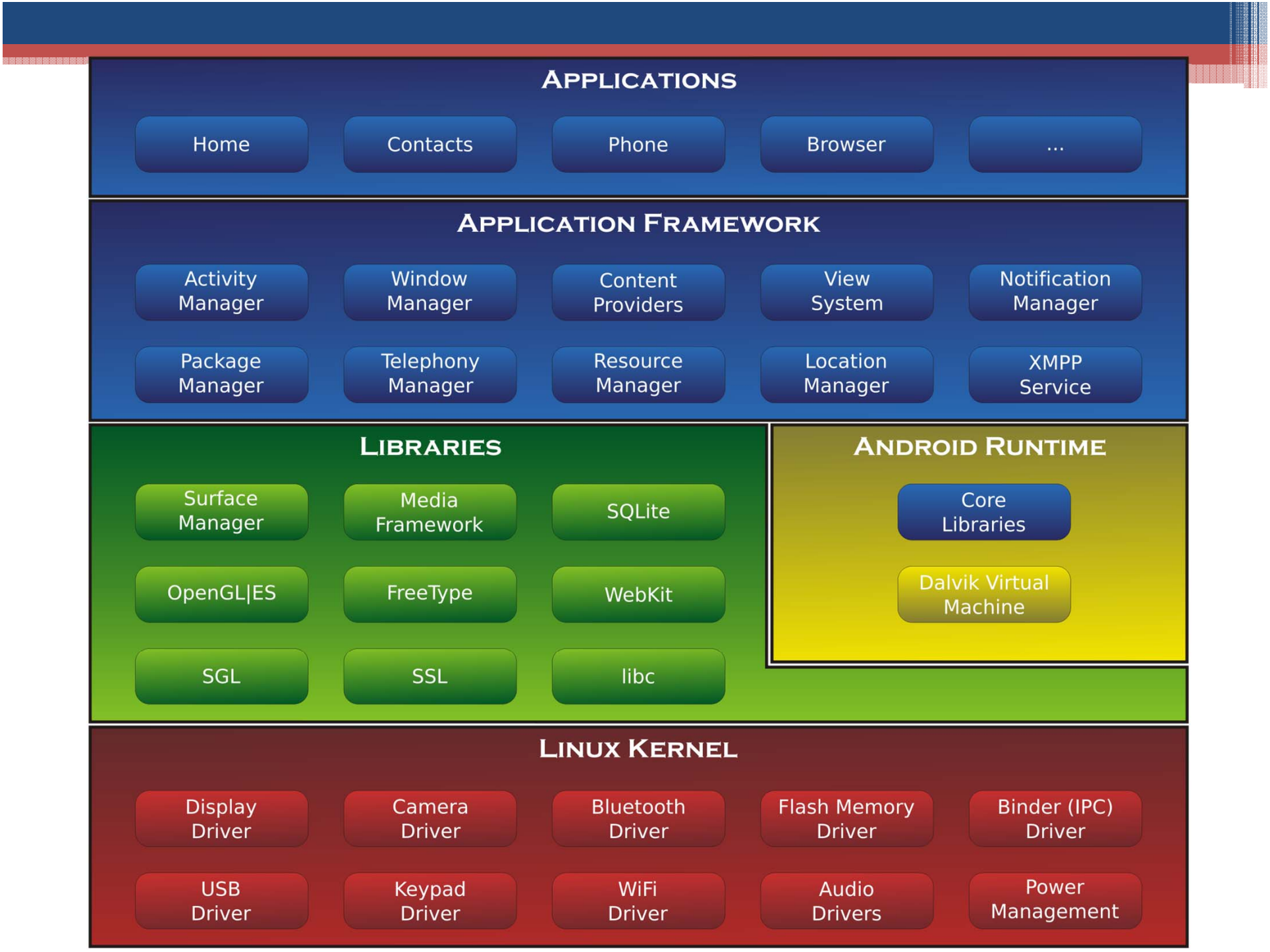
Previous Versions

Cupcake

Ice Cream Sandwich

Lollipop

- Unnamed (1.0 + 1.1)
- **C**upcake (1.5)
- **D**onut (1.6) – Quick Search Box
- **É**clair (2.1) – High Density Displays, Traffic + Navigation
- **F**royo (2.2) – Voice Control, Hotspot, Speed
- **G**ingerbread (2.3) – Simpler, Battery Life, More apps
- **H**oneycomb (3.0) – Flexible interface, tablets
- **I**ce Cream Sandwich (4.0) - Customization
- **J**elly Bean (4.1) – Google Now, actionable notifications
- **K**itKat (4.4) – “Ok Google”, voice control variety
- **L**ollipop (5.0) – fluid tactile screens
- **M**arshmallow (6.0) – battery life, app permissions, UI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Contacts
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Window Manager
Content Providers
View System
Notification Manager
Package Manager
Telephony Manager
Resource Manager
Location Manager
XMPP Service
Libraries
Surface Manager
Media Framework
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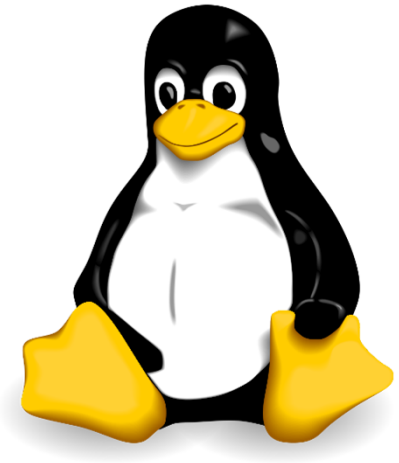
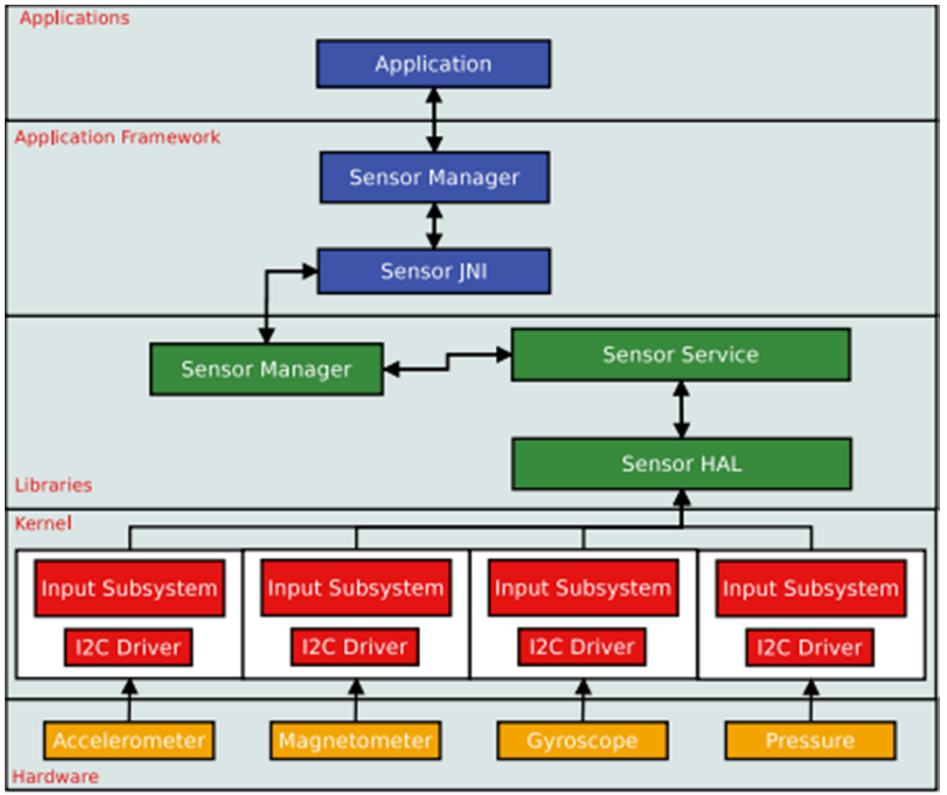
Linux Kernel



- 3.6 with ~115 patches
- Generic System Services
  - Permissions
  - Memory and Process management
  - File & Network I/O
  - Device Drivers
- Preemptive Multitasking
- Lean, efficient, and secure
- Open Source

Hardware Abstraction Layer (HAL)

- Software hooks between stack and hardware
- Hardware Specific
  - Allows Applications to be hardware ignorant

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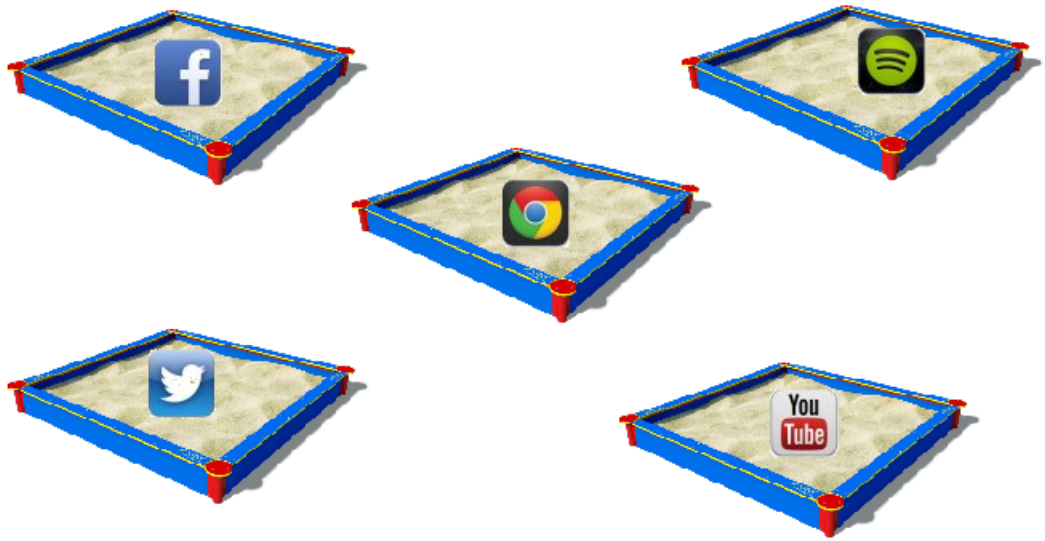
Android Runtime

- Dalvik Virtual Machine
- Core Java libraries
  - Specific to Android development
    - Apple: Swift (Objective C)
    - Windows: Visual C++ (C++), Changes with OS
  - Wrappers around C/C++ libraries
- ART (Android Runtime VM)
  - Replaced Dalvik in Lollipop (Android 5.0)
  - Advantages over Dalvik
    - AOT (Ahead of Time) Compilation
    - Improved Garbage Collection

Dalvik Virtual Machine

- Executes Android Applications
  - Each Application runs within its own VM
    - Each app is “sandboxed”
- Memory Management
- Multi-threading

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Libraries

- C/C++
- Play and record audio and video
- Internet Security
- User interface building
- Graphics
- Database access

Library Examples

- WebKit
  - Web Browser Engine
- OpenGL
  - High Performance Graphics
  - Render 2D or 3D Graphic Content
- libc
  - Generic C library
- SQLite
  - Storage and sharing of application data

Library Examples Cont.

- Surface Manager
  - Off-screen buffering
    - Apps can't directly draw into screen
    - Drawings go to off-screen buffer
    - Combined with other drawings
    - Reason behind window transparency
- Media Framework
  - Provides media codecs allowing recording and playback of different types of media


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Application Framework

- Higher Level Services to Applications
- Environment in which applications are run and managed
- Package Manager
  - Keeps track of installed Applications
  - Apps can communicate with other Apps on device
- Window Manager
  - Manages main window that comprises Application

Application Framework Cont.

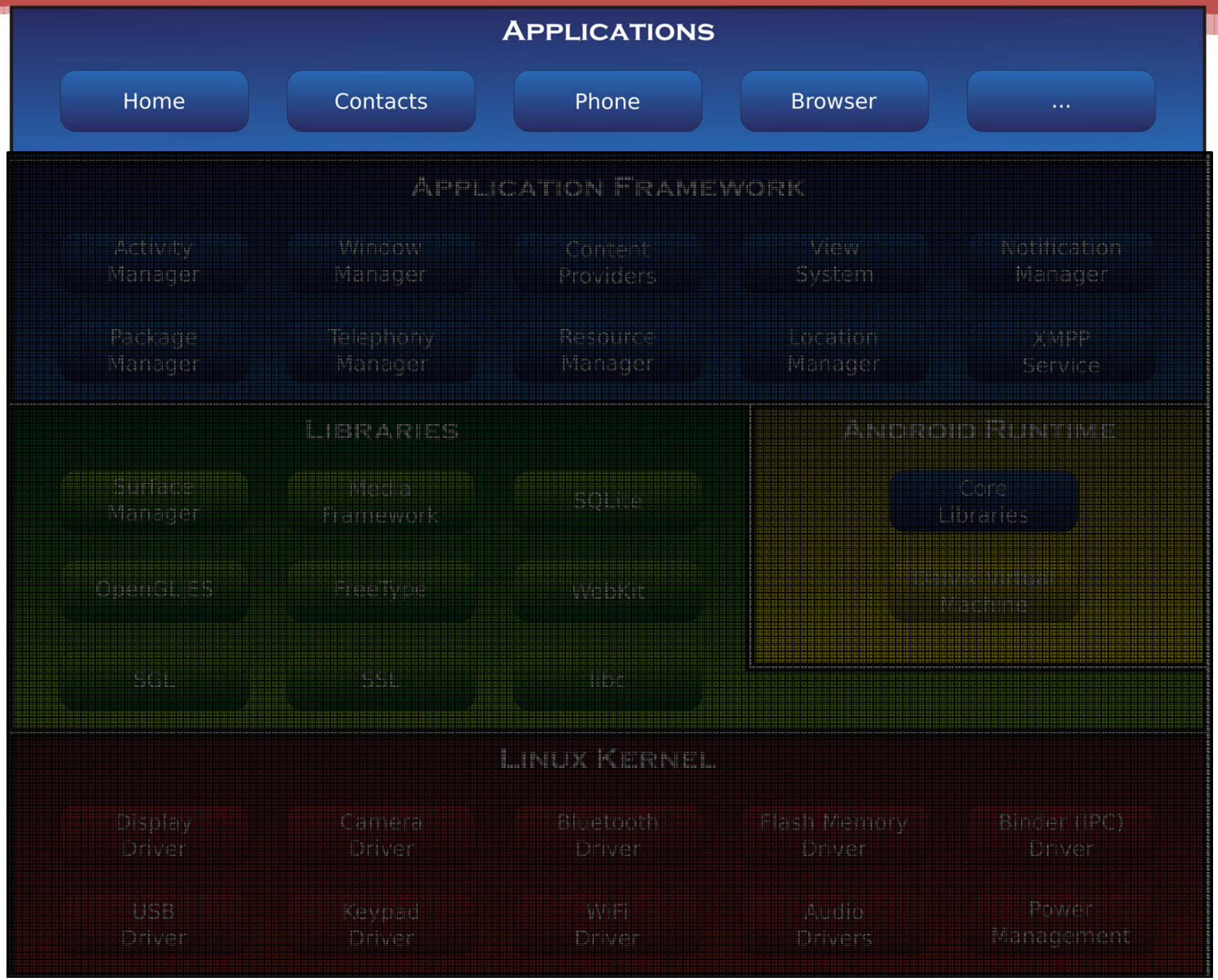
- View System
  - Provide Common User Interface Elements
    - Icons
    - Buttons
    - Text Entry
    - Etc.
- Content Providers
  - Databases that allow application to store and share structured info

Application Framework Cont.

- Location Manager
  - Allows application to receive location and movement info generated by GPS
- Activity Manager
  - Manages activity life cycle of applications
- Telephony Manager
  - Manages all voice calls

Application Framework Cont.

- Resource Manager
  - Manage various types of resources used in applications
  - Allows access to non-code embedded resources
    - Strings
    - Color settings
    - UI Layout
- Notifications Manager
  - Allows applications to display alerts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Applications

- Hosts Android Applications
- Written in Java
  - Access to all Android APIs
- Executed in the VM (Dalvik or ART)
- Examples
  - SMS client app
  - Dialer
  - Web Browser
  - Contact manager

Conclusion

- **Designed** for mobile and flexibility
  - Both in software and hardware
- 5 Layers
- Application Development
  - Simple
    - Java
  - Access to all aspects of the Kernel
    - Open Source
    - APIs