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CMSC436: Programming Handheld Systems

The Android Platform

The Android Platform

A software stack for mobile devices:

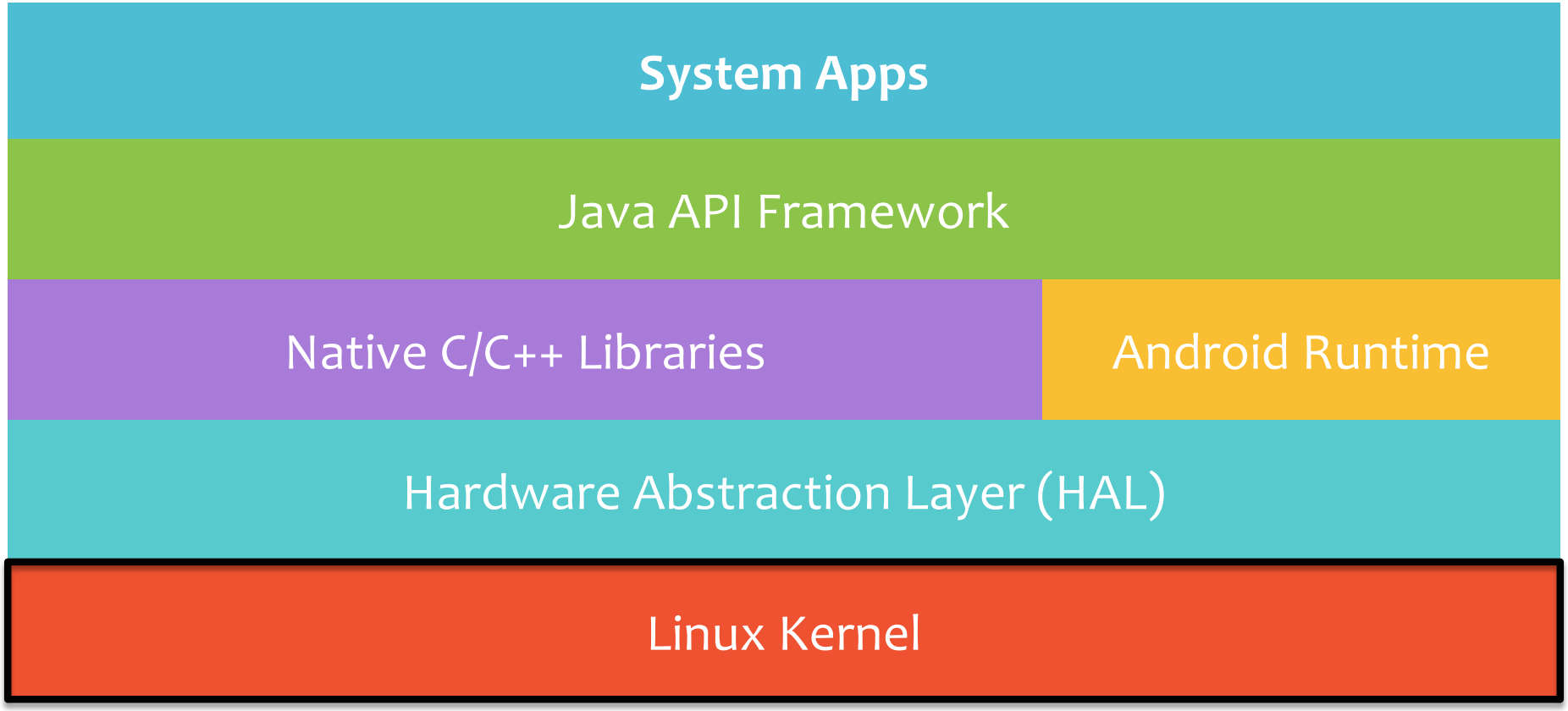
- OS kernel and interfaces, system libraries, frameworks & key apps

Android SDK for creating apps

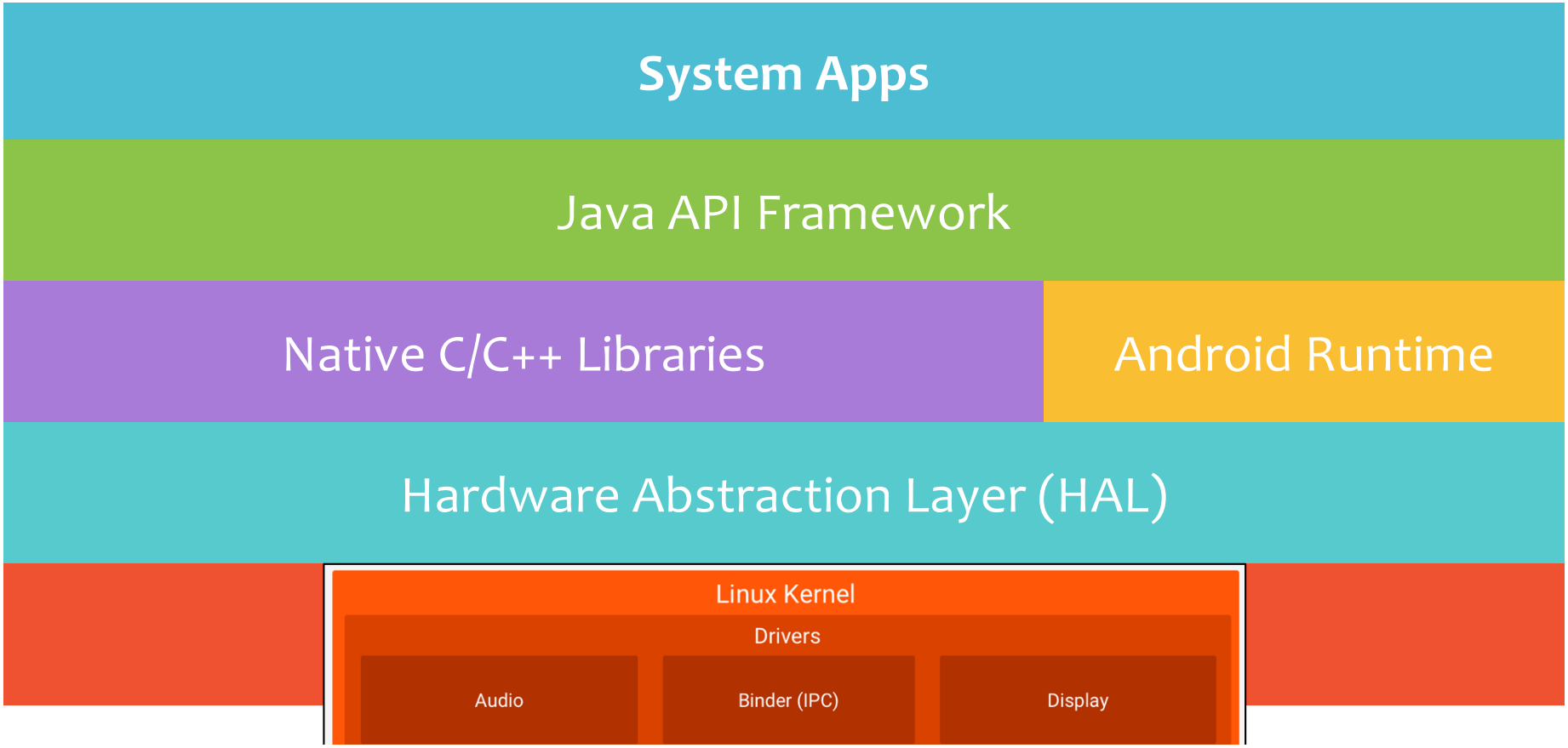
- Libraries & development tools
- Lots of documentation. Start browsing today!

See: https://developer.android.com/training

The Android Architecture



The Android Architecture



Linux Kernel – Standard Services

Security

Memory & process management

File & network I/O

Device drivers

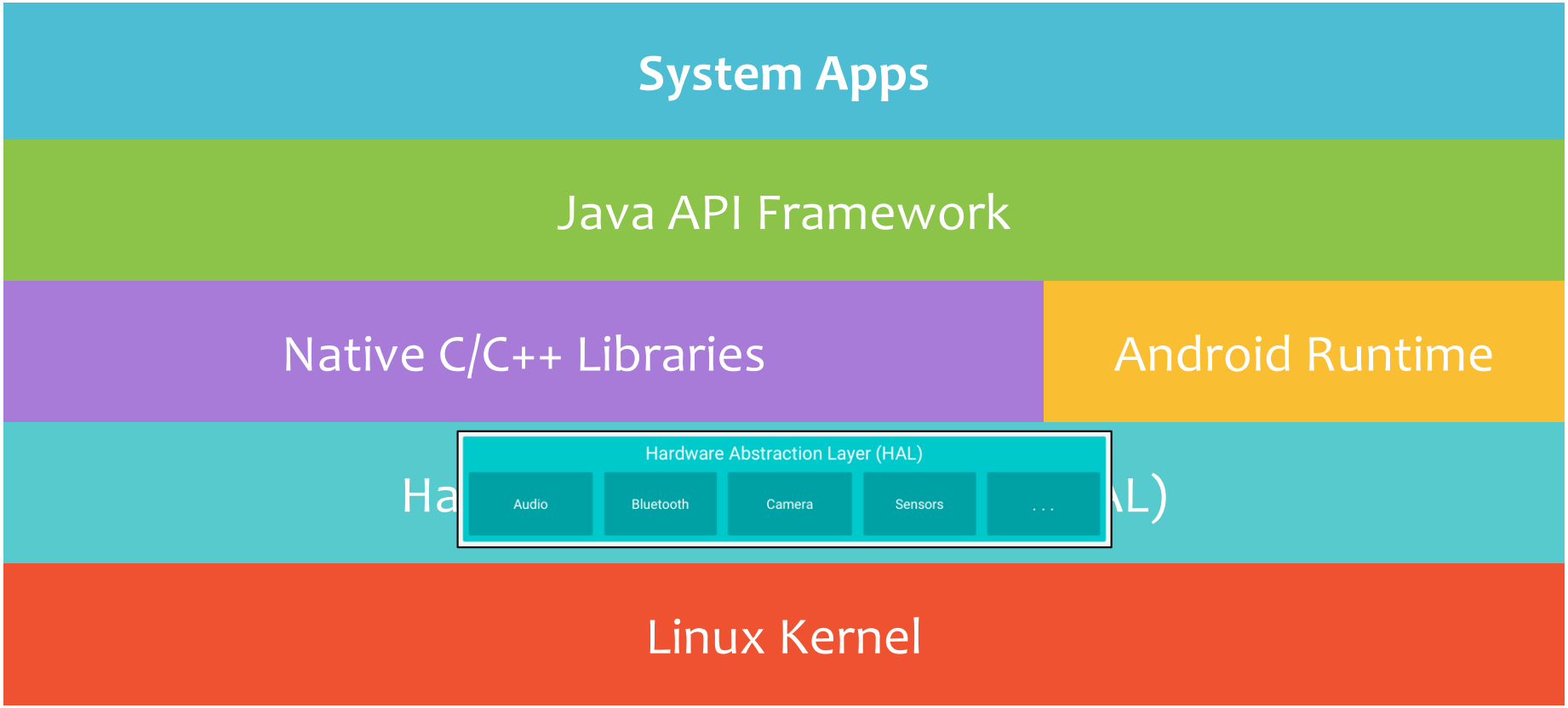
Linux Kernel - Android-Specific

Power management

Low memory killer

Interprocess communication (IPC)

The Android Architecture



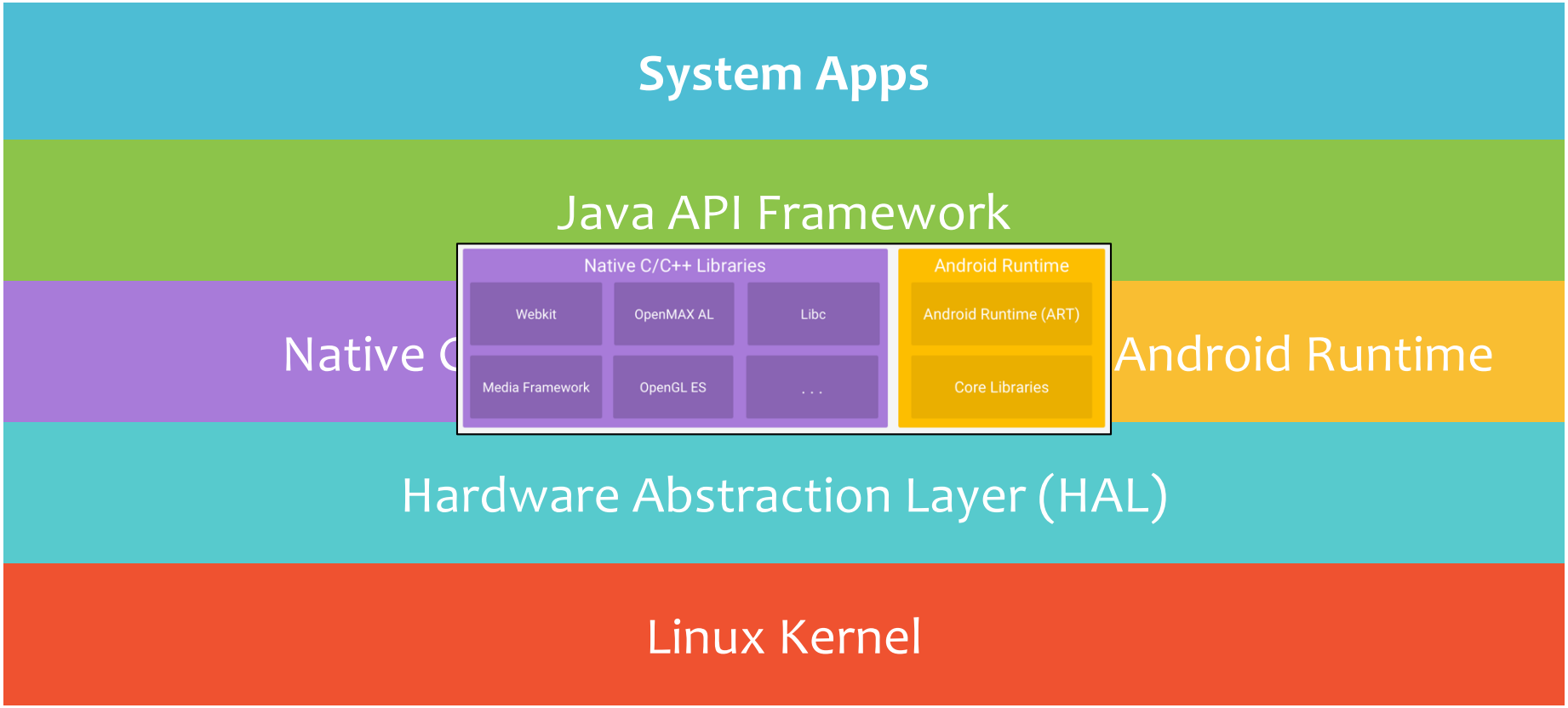
Hardware Abstraction Layer (HAL)

Provides standard interfaces between API framework and device hardware

Defines and interface for various hardware classes, such as Camera, Audio, Sensors, etc.

Android loads library modules for hardware components on demand

The Android Architecture



Libraries

Bionic libc

Surface Manager

Media Framework

FreeType

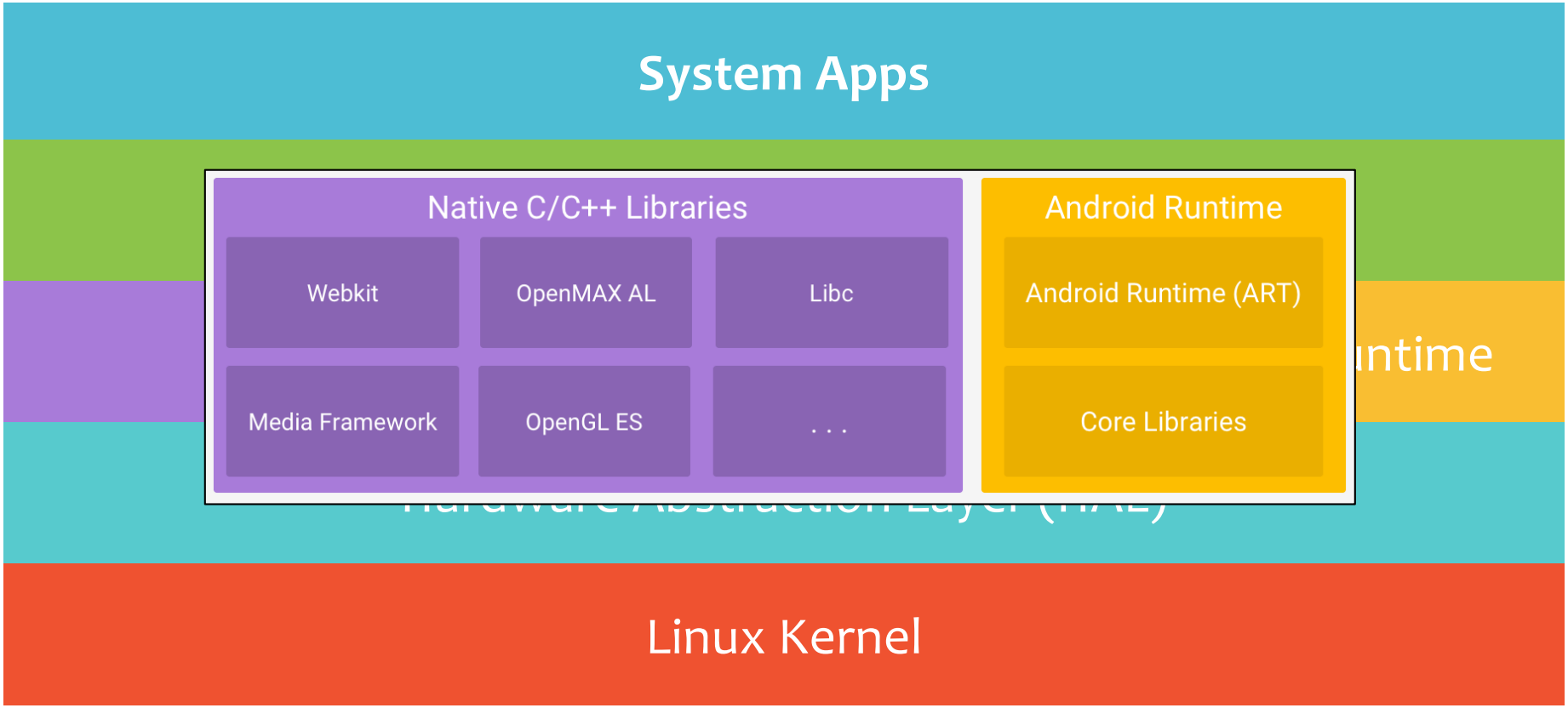
Webkit

OpenGL

SQLite

SSL

The Android Architecture



Android Runtime

- Two main components
  - Core Java libraries with some Java 8+ feature support
  - Android Runtime (ART)

Core Java Libraries

Basic java classes -- java.*, javax.*

App lifecycle, basic services -- android.*, androidx

Internet/Web services -- org. *

Unit testing -- junit.*

Java 8+ support

Android does not support all Java 8+ language features

Some supported features (in API level 24 or higher)

- Lambda expressions
- Method references
- java.util.function and java.util.stream

See: https://developer.android.com/studio/write/java8-support

Android Runtime (ART)

Since Android 5.0, apps are executed in a managed runtime environment (ART)

On older platforms, apps run in the Dalvik Virtual Machine

ART Design Goals

- Designed for resource-constrained environments
  - Slower CPU
  - Less RAM
  - Limited battery life

Major ART Features

Ahead-of-time (AOT) and just-in-time (JIT) compilation

Optimized garbage collection (GC)

API level 28+ conversion of an app package's Dalvik Executable format (DEX) files to more compact machine code

Better debugging support, including a dedicated sampling profiler, detailed diagnostic exceptions and crash reporting, and the ability to set watchpoints to monitor specific fields

Notional Workflow

App written in Java, Kotlin or C++

Compiled to Java bytecode files

Tool chain converts java bytecode files to a single dex-formatted bytecode file

Bytecodes (and other resources) installed on device

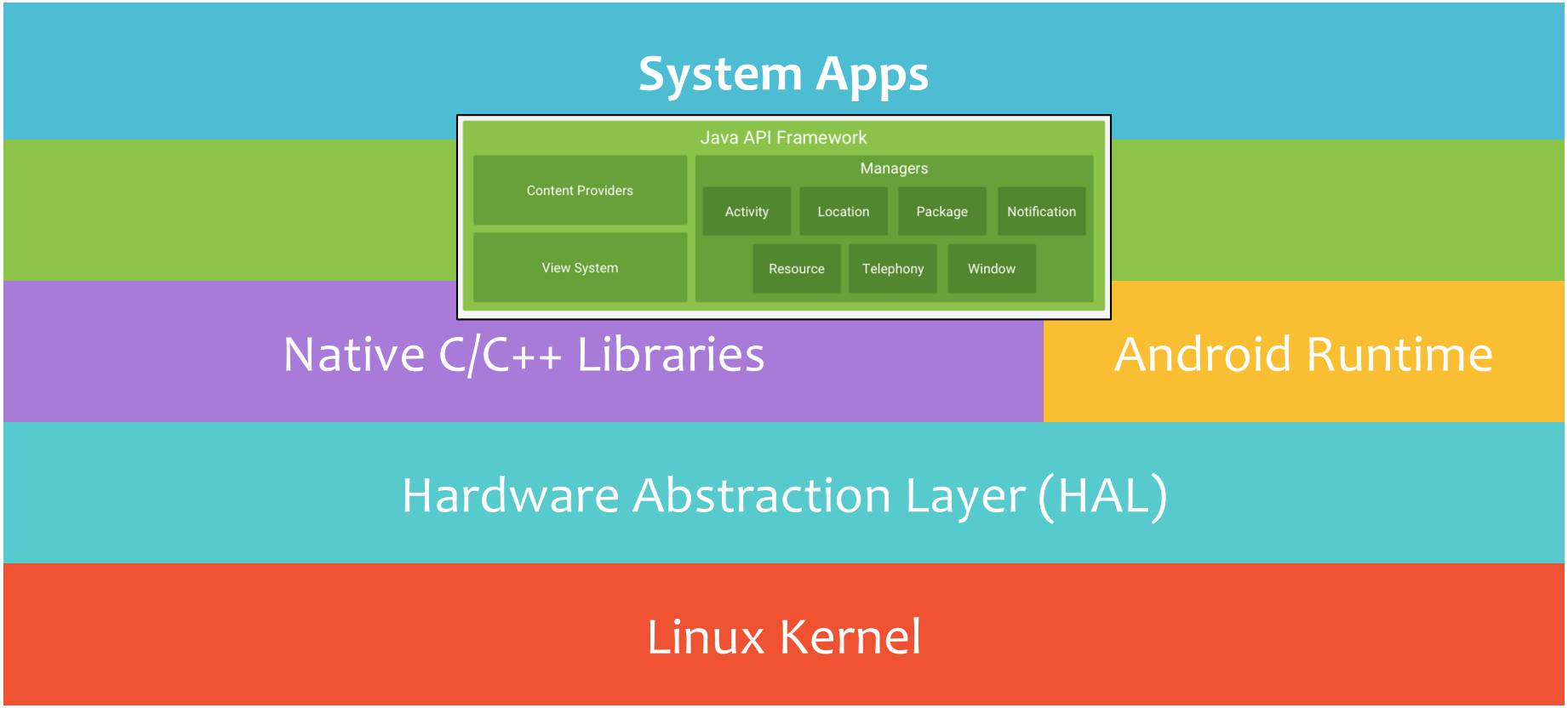
ART

Compiles dex bytecode to native binary for improved runtime performance

Applies system-dependent optimizations at installation time, runtime, and in background

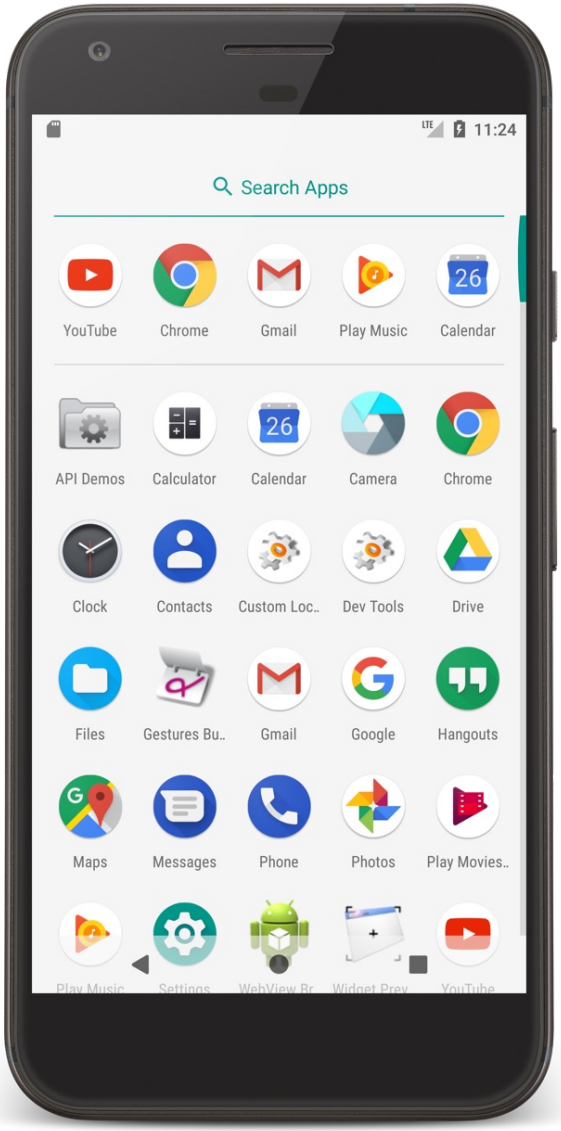
Results in faster execution at cost of larger executable

The Android Architecture



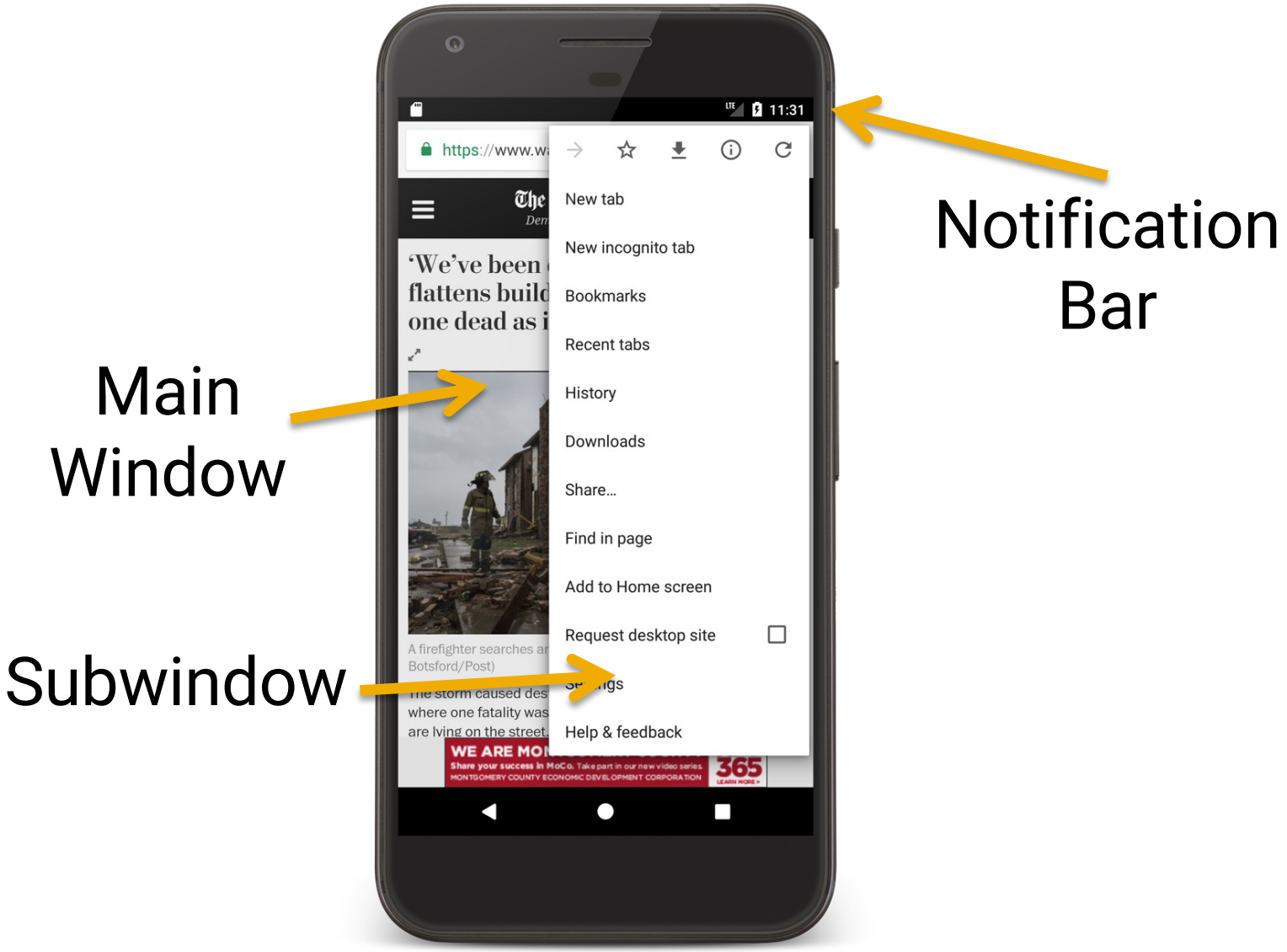
Package Manager

Keeps track of app packages on device


11:24
Search Apps
YouTube
Chrome
Gmail
Play Music
Calendar
API Demos
Calculator
Calendar
Camera
Chrome
Clock
Contacts
Custom Loc..
Dev Tools
Drive
Files
Gestures Bu..
Gmail
Google
Hangouts
Maps
Messages
Phone
Photos
Play Movies..
Play Music
Settings
WebView Br..
Widget Prev..
YouTube

Window Manager

Manages the windows comprising an app

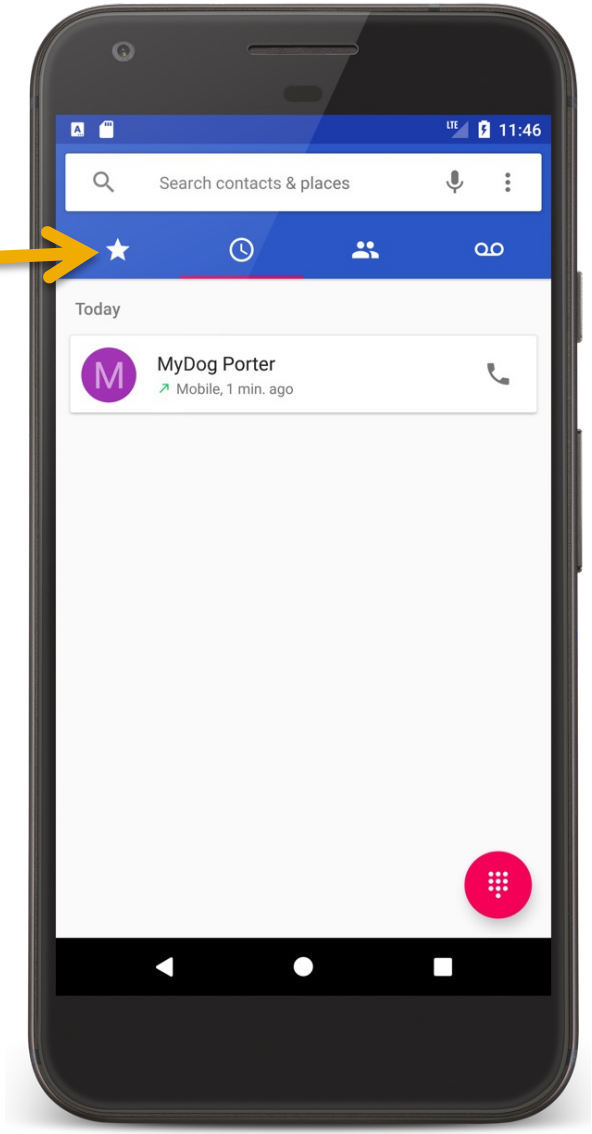

Notification Bar
Main Window
Subwindow
11:31
New tab
New incognito tab
Bookmarks
Recent tabs
History
Downloads
Share...
Find in page
Add to Home screen
Request desktop site
Help & feedback

View System

Provides common user interface elements

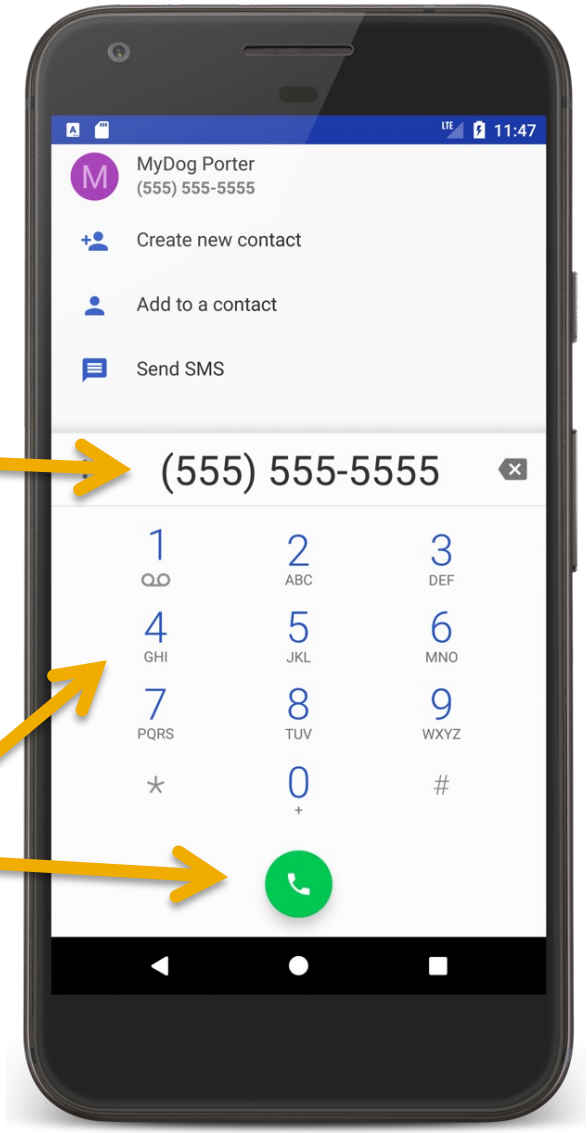
- e.g., icons, text entry boxes, buttons and more

Tabs


11:46
Search contacts & places
Today
MyDog Porter
Mobile, 1 min. ago

TextView

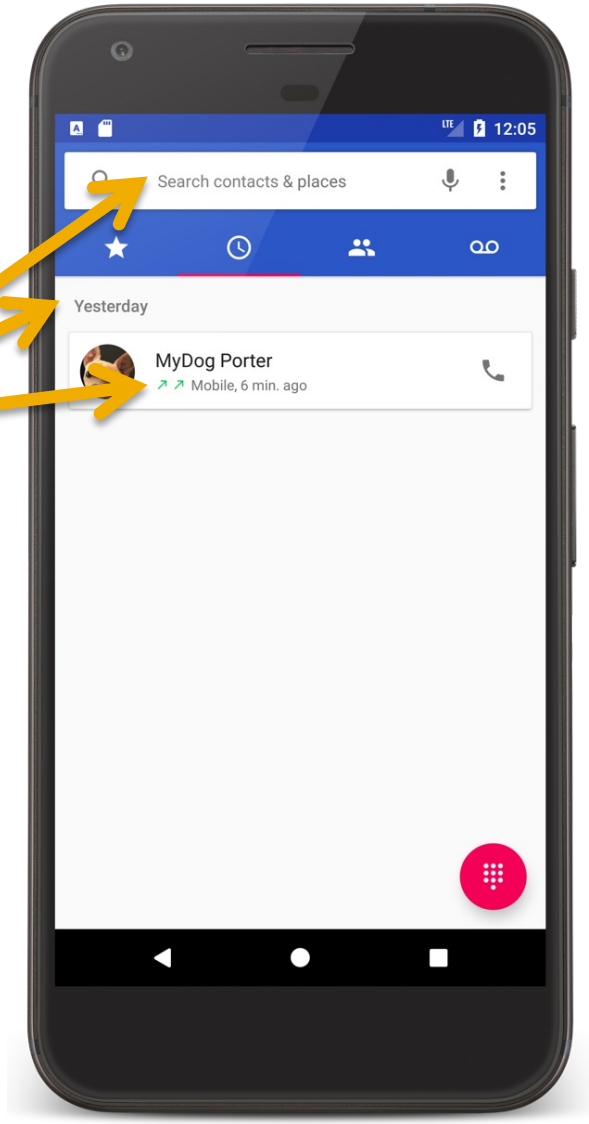
Buttons

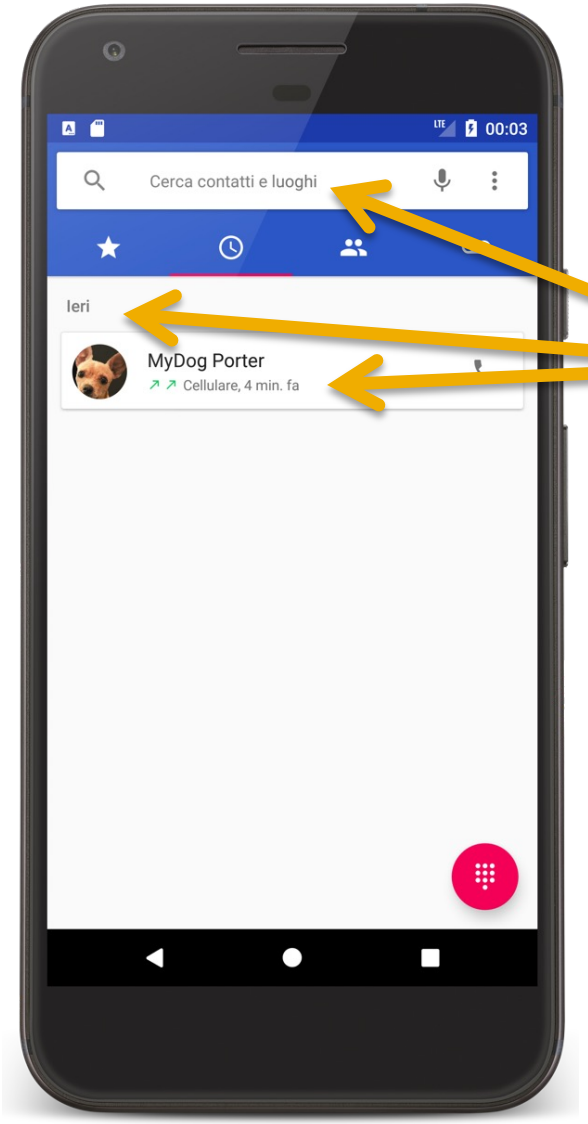


Resource Manager

- Manages non-compiled resources
  - e.g., strings, graphics, & layout files

English Strings

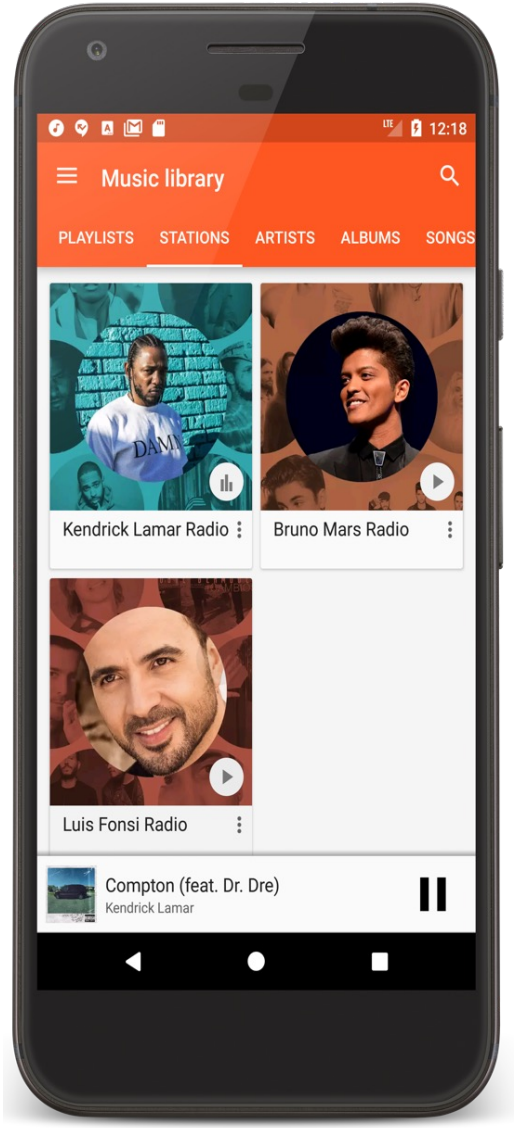


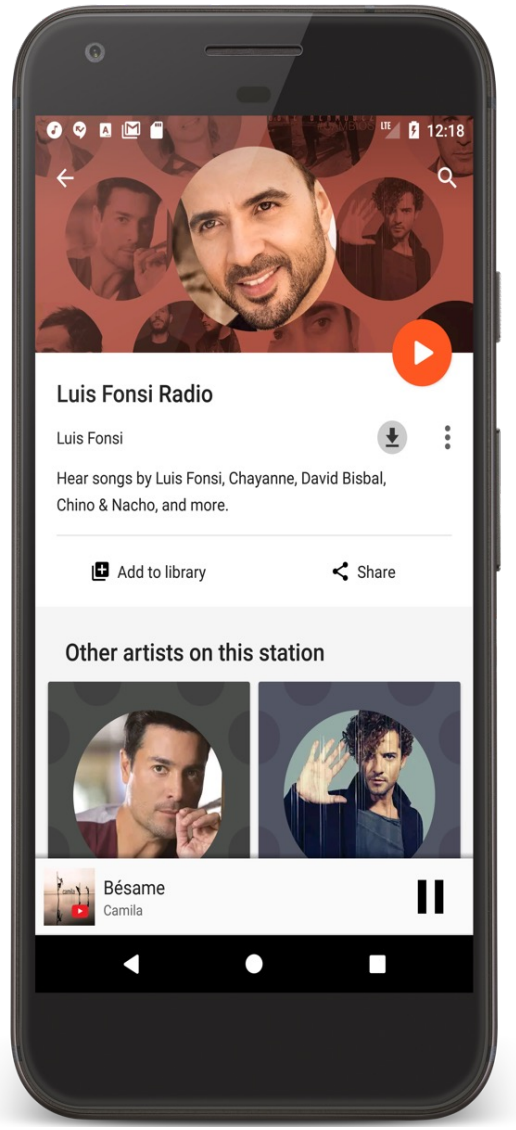


Italian Strings

Activity Manager

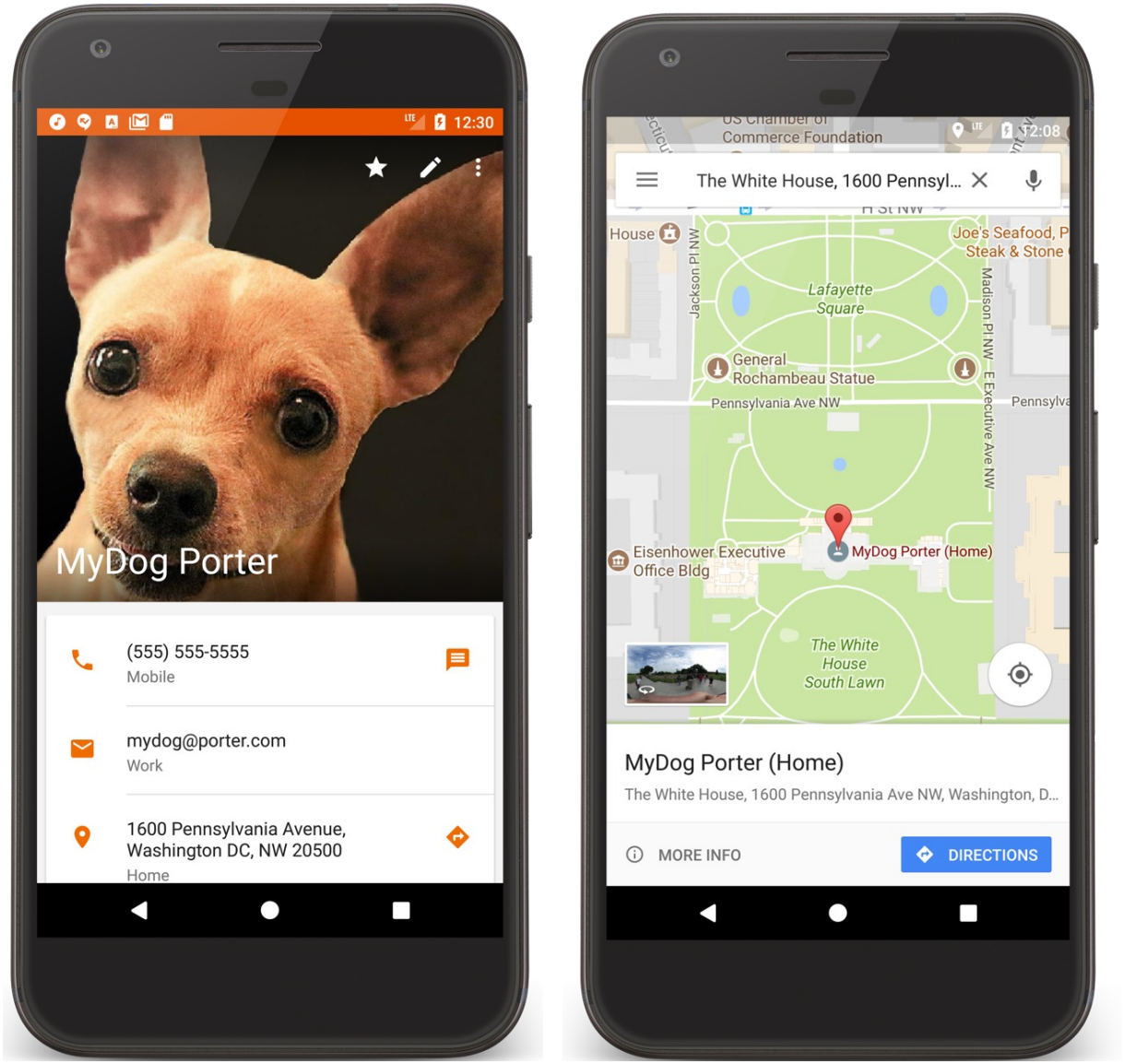
Manages app lifecycle and navigation stack


12:18
Music library
PLAYLISTS
STATIONS
ARTISTS
ALBUMS
SONGS
Kendrick Lamar Radio
Bruno Mars Radio
Luis Fonsi Radio
Compton (feat. Dr. Dre)
Kendrick Lamar


12:18
Luis Fonsi Radio
Luis Fonsi
Hear songs by Luis Fonsi, Chayanne, David Bisbal, Chino & Nacho, and more.
Add to library
Share
Other artists on this station
Bésame
Camila

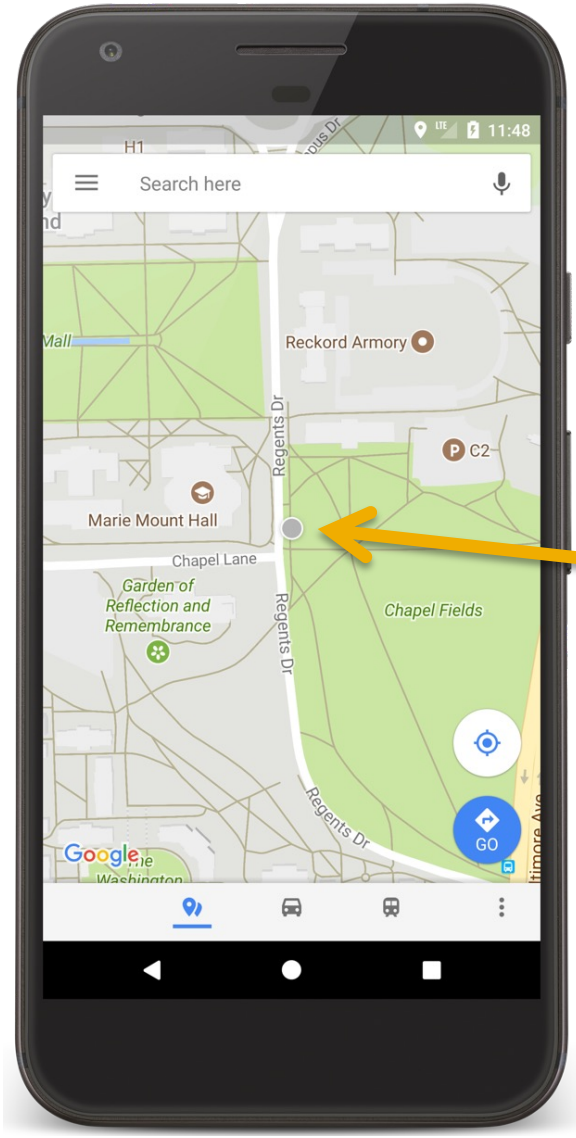
ContentProvider

Inter-application data sharing


12:30
MyDog Porter
(555) 555-5555
Mobile
mydog@porter.com
Work
1600 Pennsylvania Avenue,
Washington DC, NW 20500
Home
The White House, 1600 Pennsyl...
House
Lafayette
Square
General
Rochambeau Statue
Pennsylvania Ave NW
Jackson Pl NW
Madison Pl NW
Eisenhower Executive
Office Bldg
MyDog Porter (Home)
The White
House
South Lawn
MyDog Porter (Home)
The White House, 1600 Pennsylvania Ave NW, Washington, D...
MORE INFO
DIRECTIONS

Location Manager

Provides location & movement information



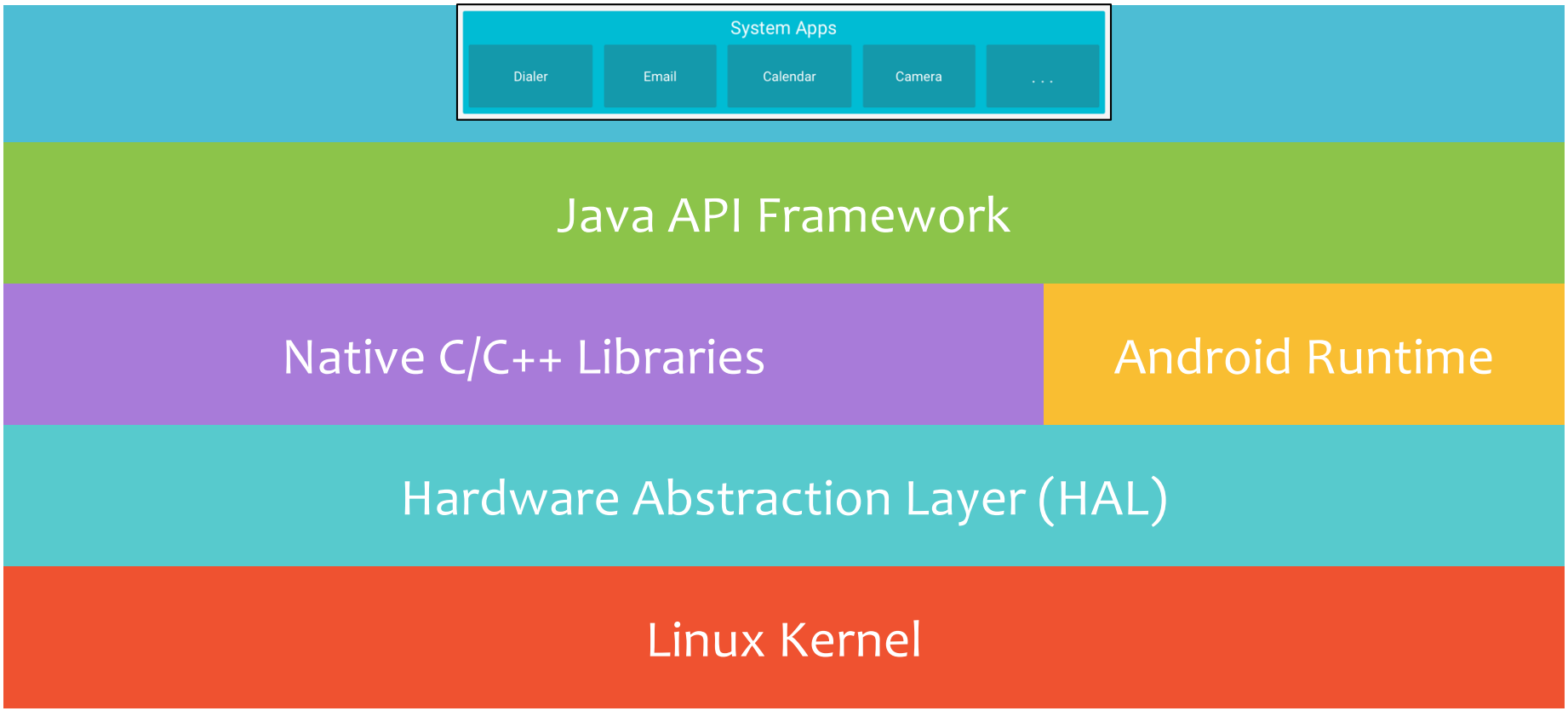
User's Location

Notification Manager

Place notification icons in the status bar area when important events occur

12:51
August 27
SUNDAY, 2017
Maps
12:49
August 27
SUNDAY, 2017
Maps
Android
100%
12:49
Sun, Aug 27
Messages • now
MyDog Porter
"I is hongry. Feed pleeze."
MARK AS READ
REPLY
CLEAR ALL
Maps

The Android Architecture



Applications

Standard apps include:

- Home – main screen
- Contacts – contacts database
- Phone – dial phone numbers
- Browser – view web pages
- Email reader –compose & read email messages

Applications

Nothing special about these apps

You can substitute your own or 3rd party app for any of them

Next

Android Development Environment