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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

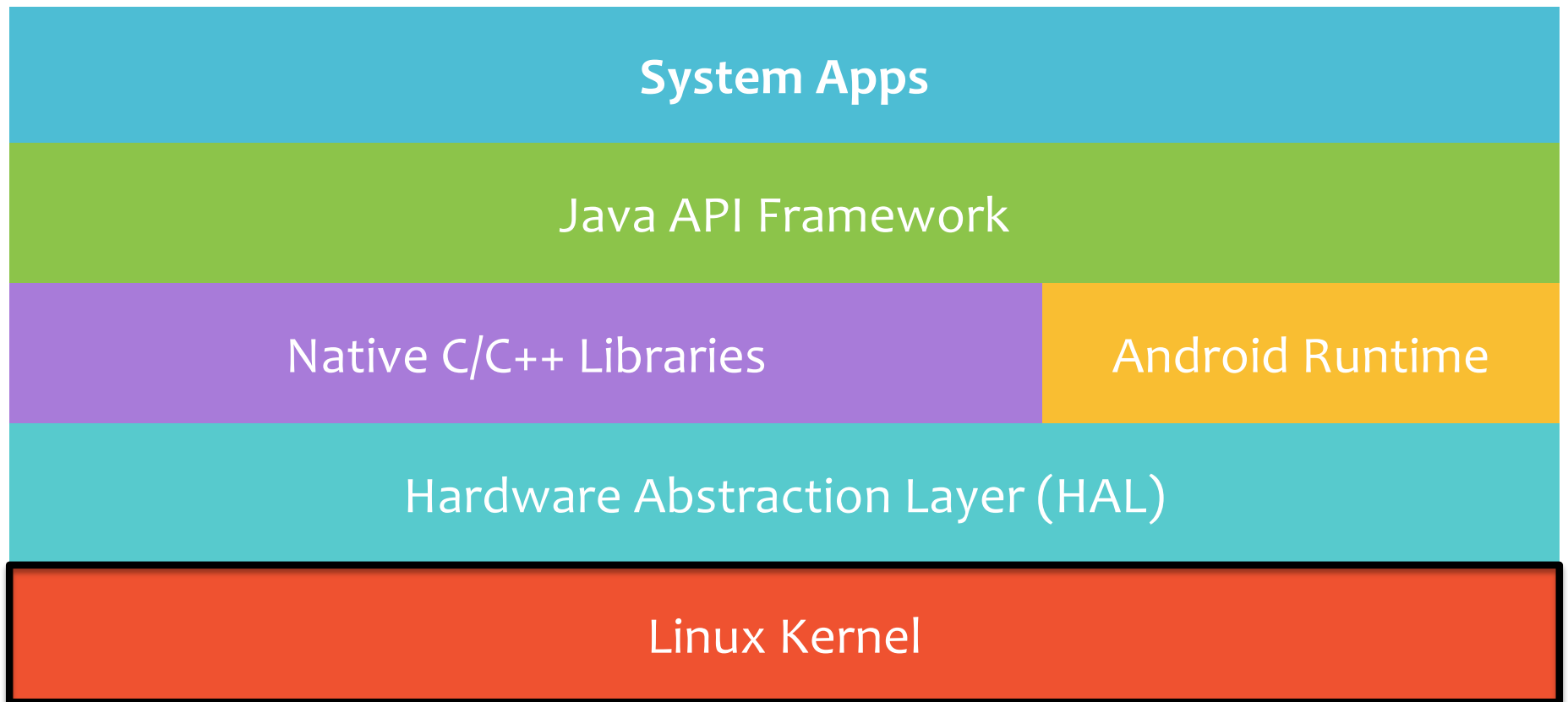
Android SDK for creating apps

Libraries & development tools

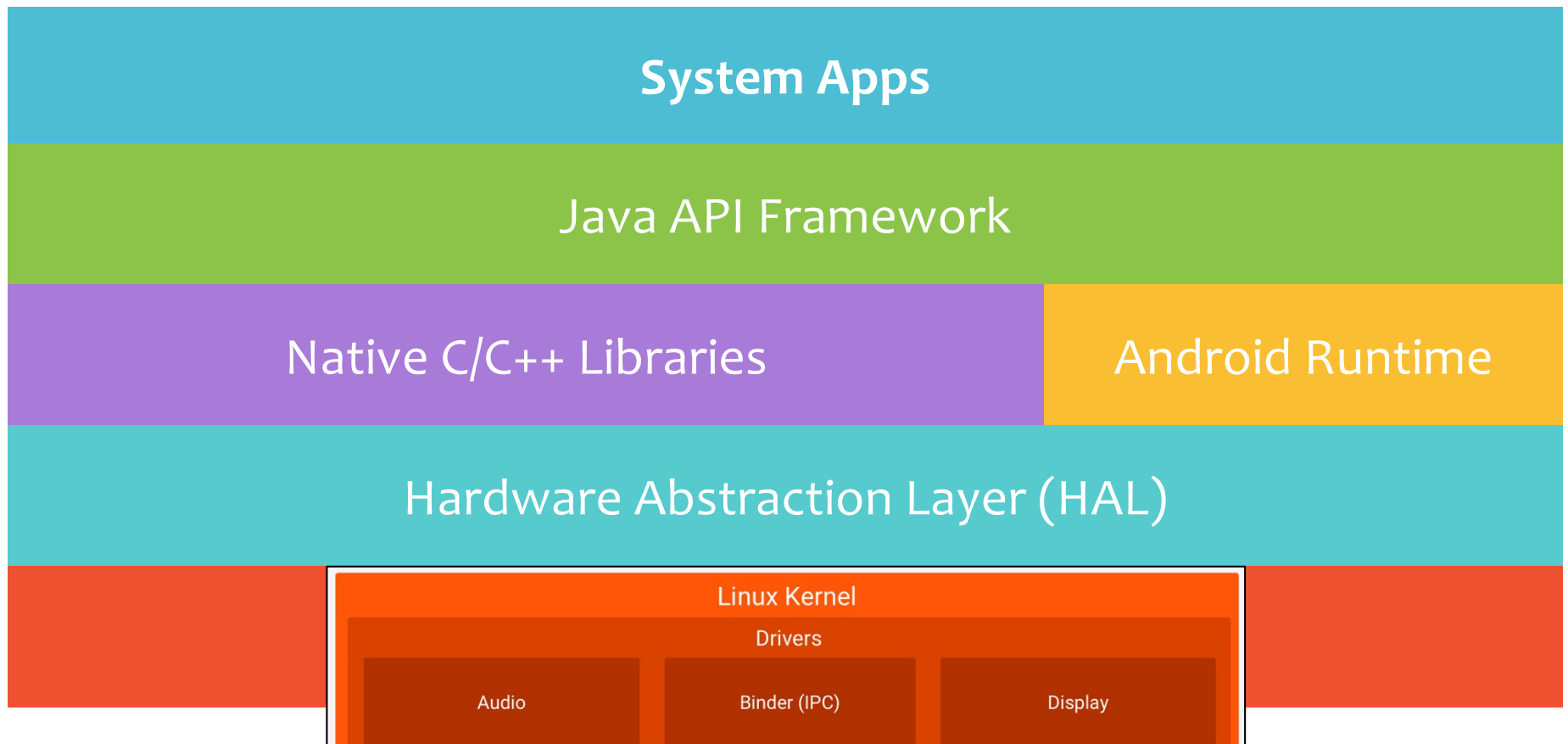
Lots of documentation. Start browsing today!

See: <http://developer.android.com/training>

The Android Architecture



The Android Architecture



Linux Kernel – Standard Services

Security

Memory & process management

File & network I/O

Device drivers

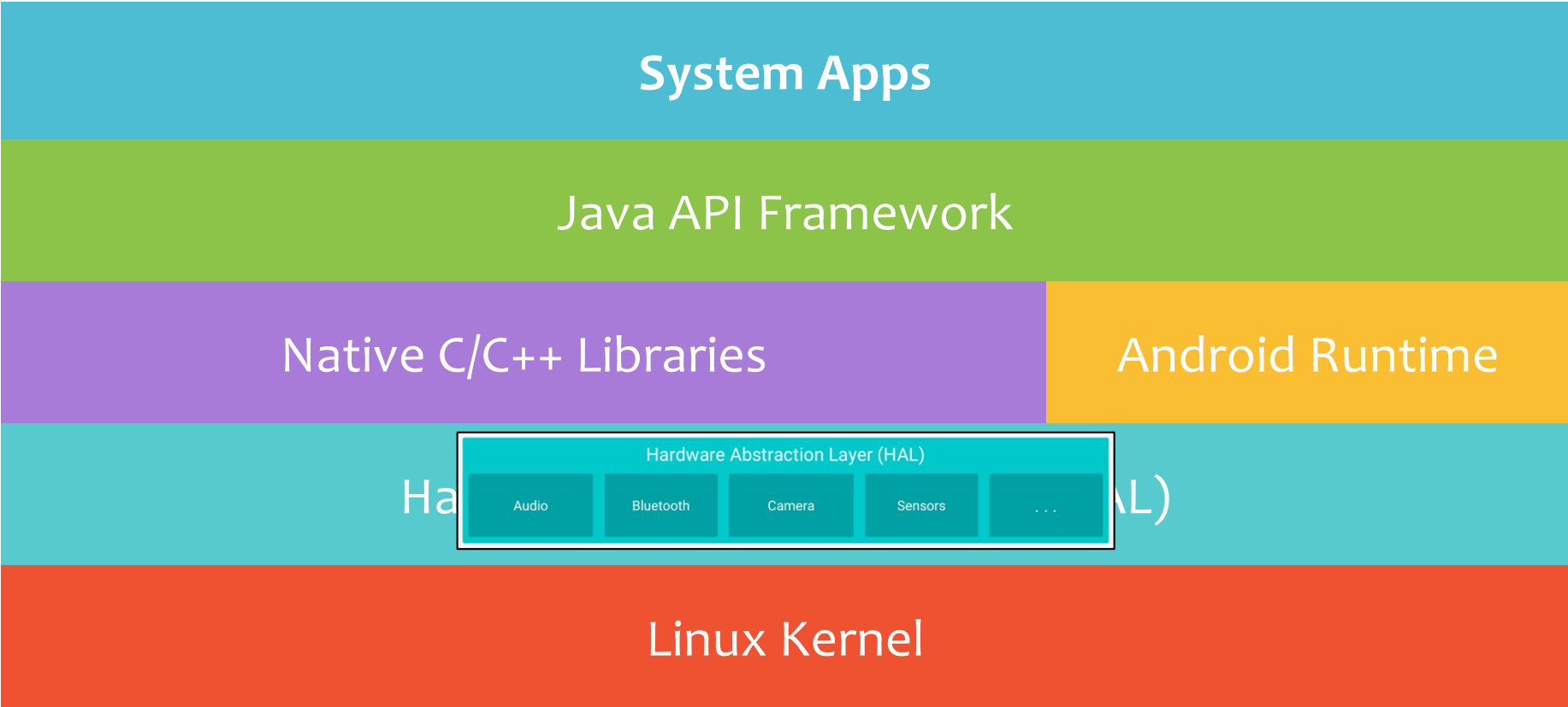
Linux Kernel - Android-Specific

Power management

Low memory killer

Interprocess communication (IPC)

The Android Architecture



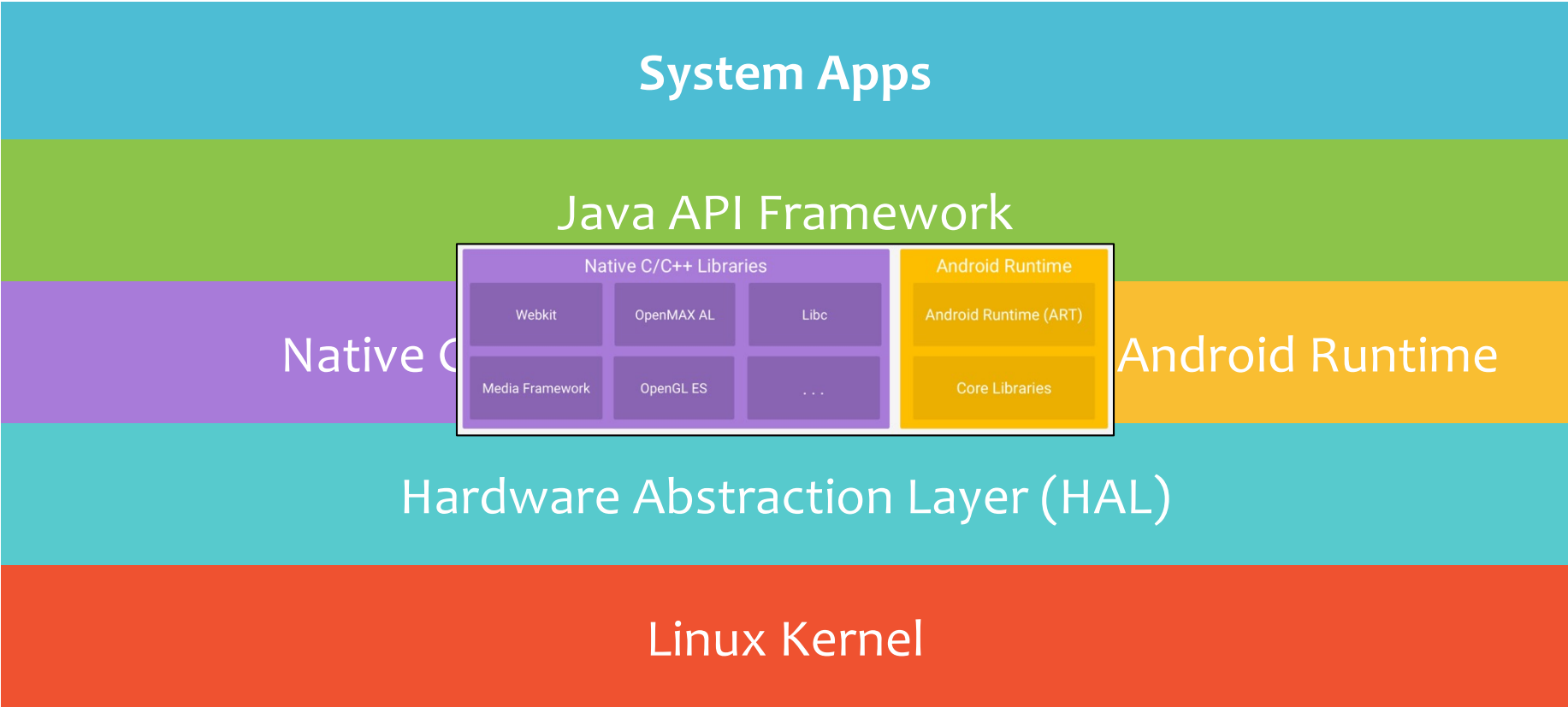
Hardware Abstraction Layer (HAL)

Provides standard interfaces between API framework and device hardware

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

Android loads library modules for hardware components on demand

The Android Architecture



Libraries

Bionic libc

Surface Manager

Media Framework

FreeType

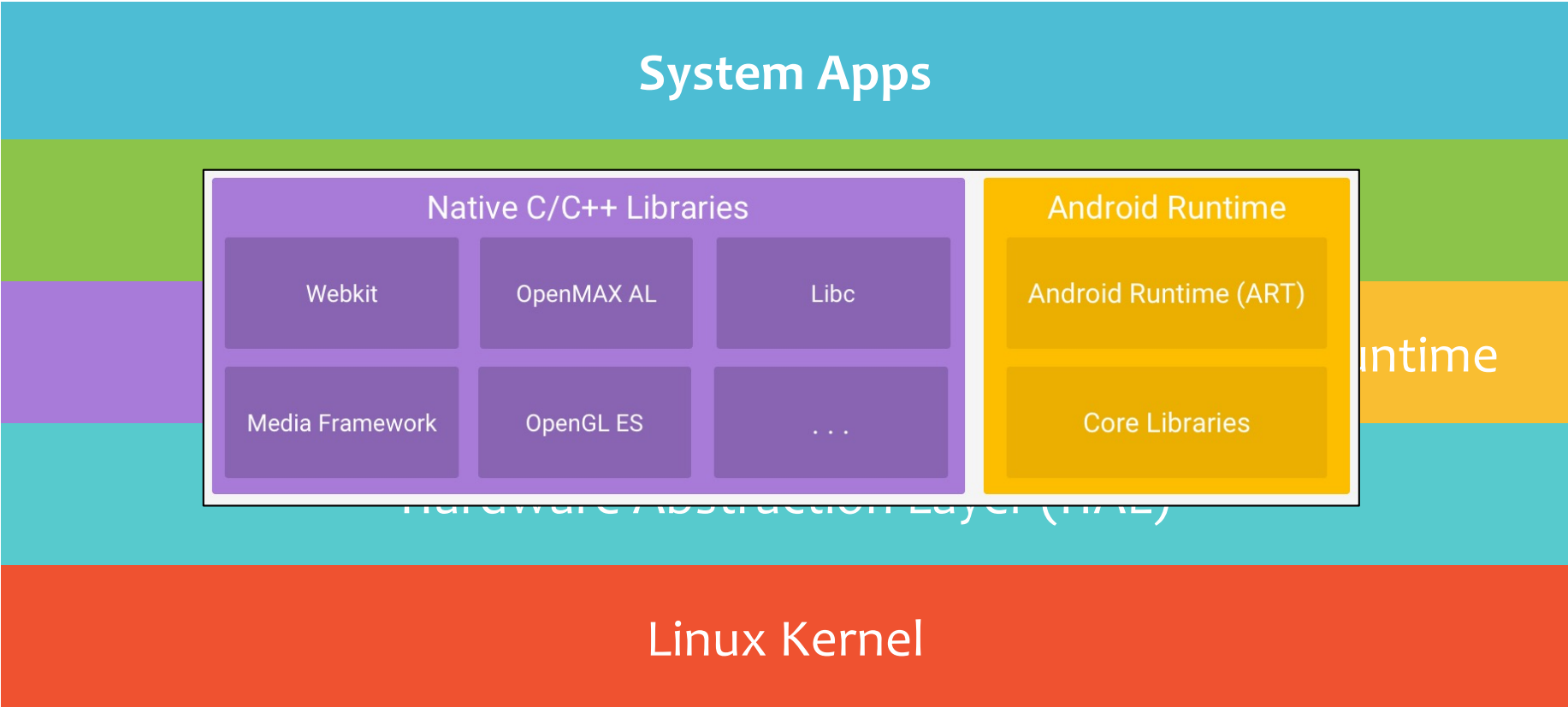
Webkit

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

Typical 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

Virtual machine executes bytecode file

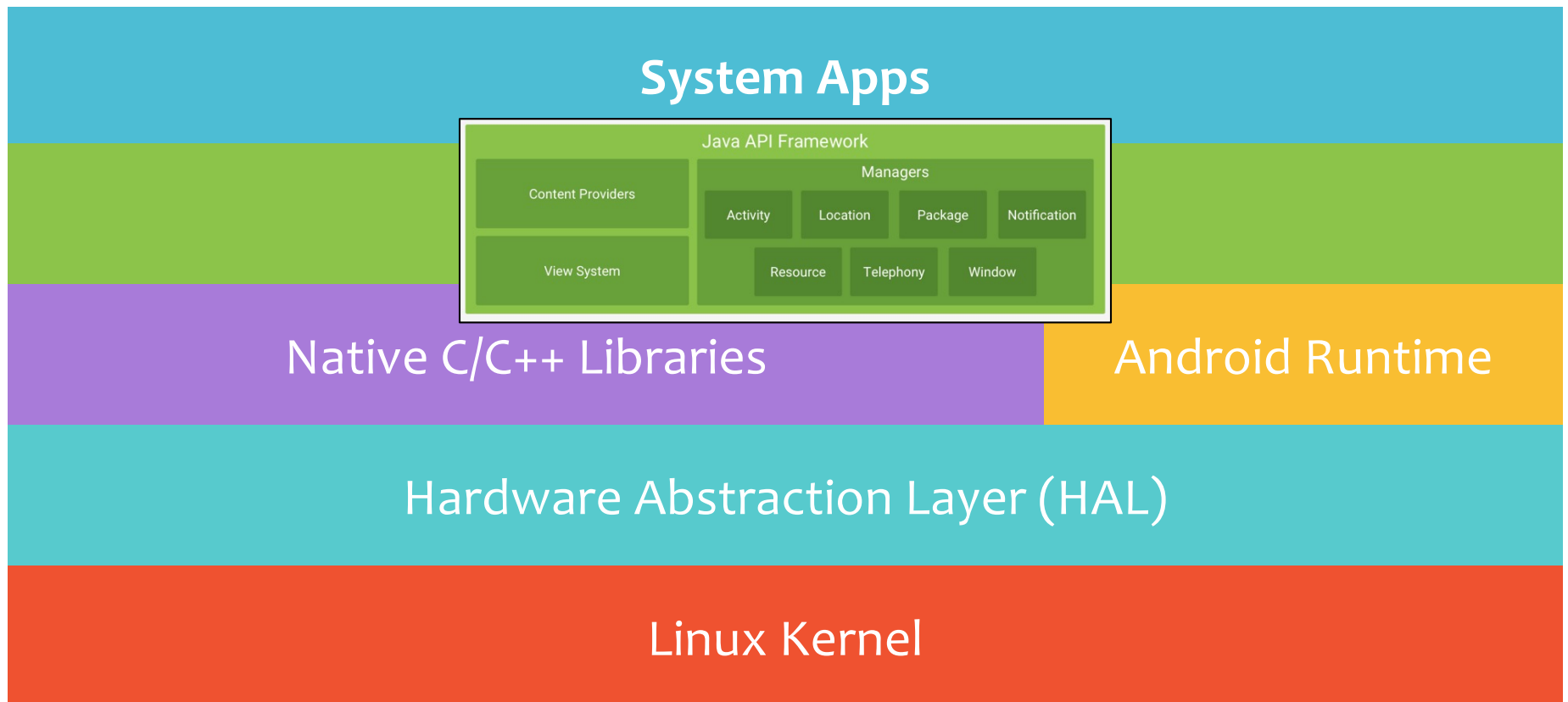
ART

Compiles dex bytecode to native binary for improved runtime performance

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

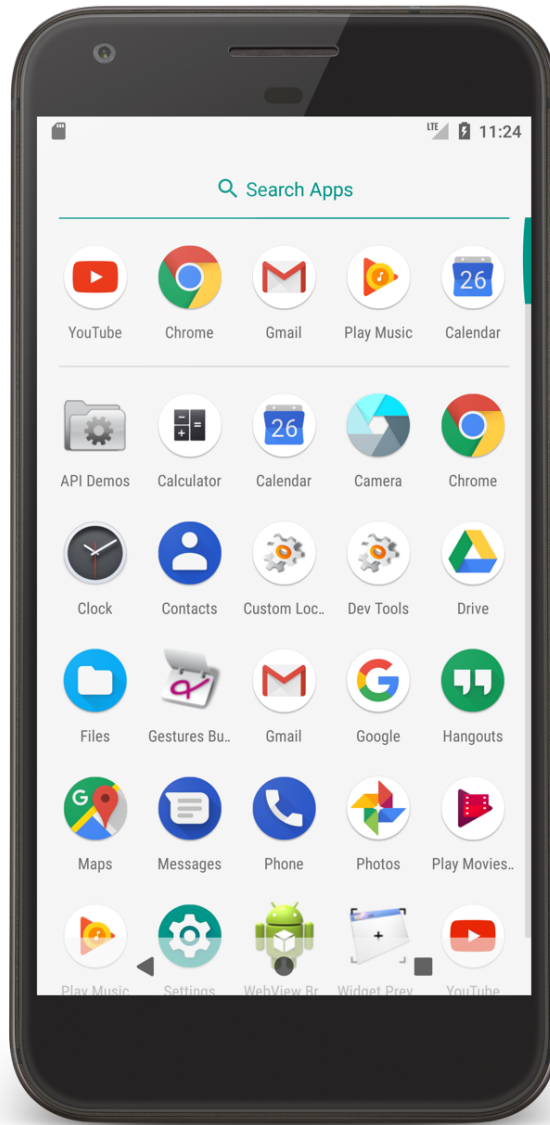
Results in faster execution at cost of larger executable

The Android Architecture



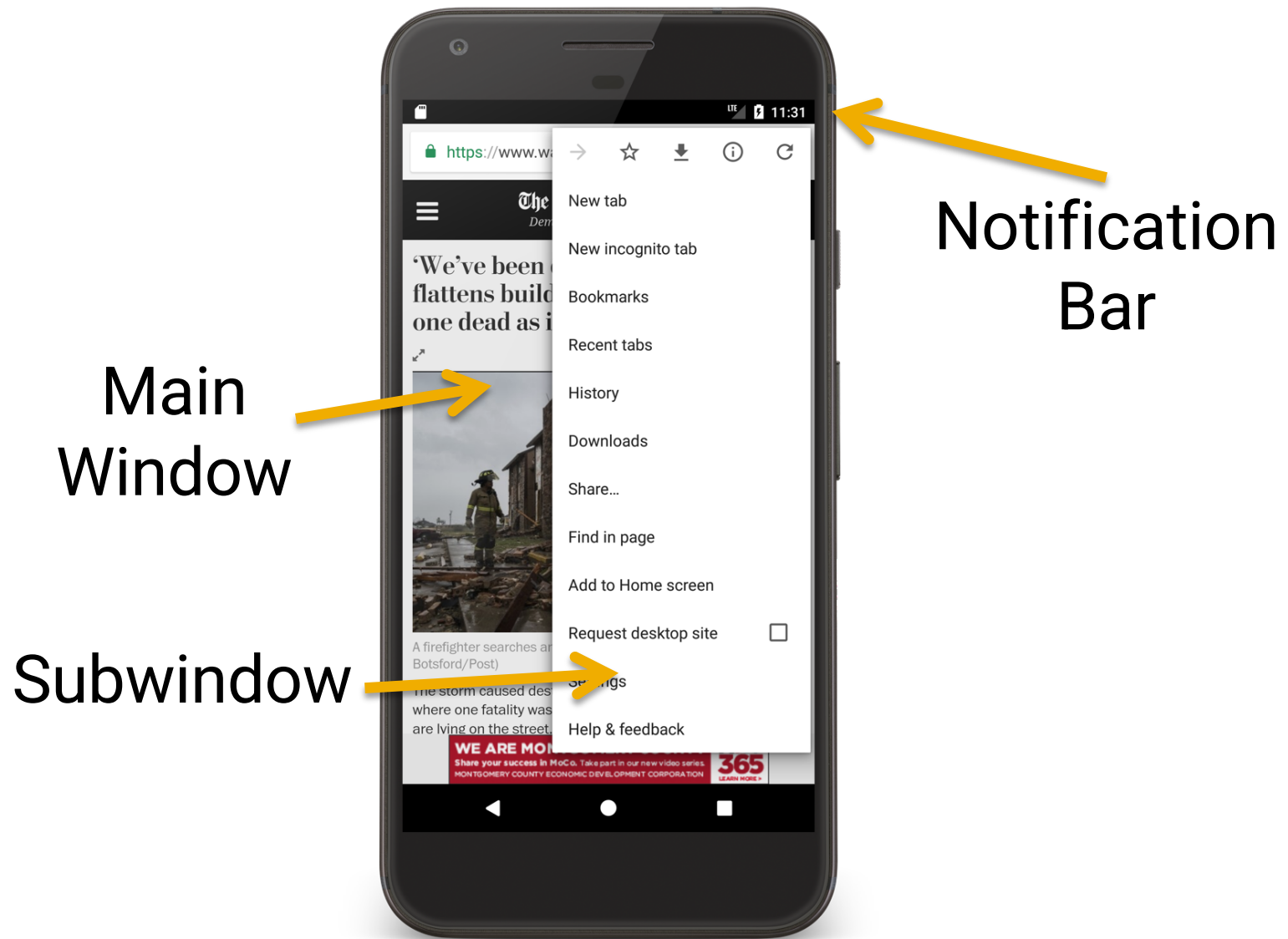
Package Manager

Keeps track of app packages on device



Window Manager

Manages the windows comprising an app

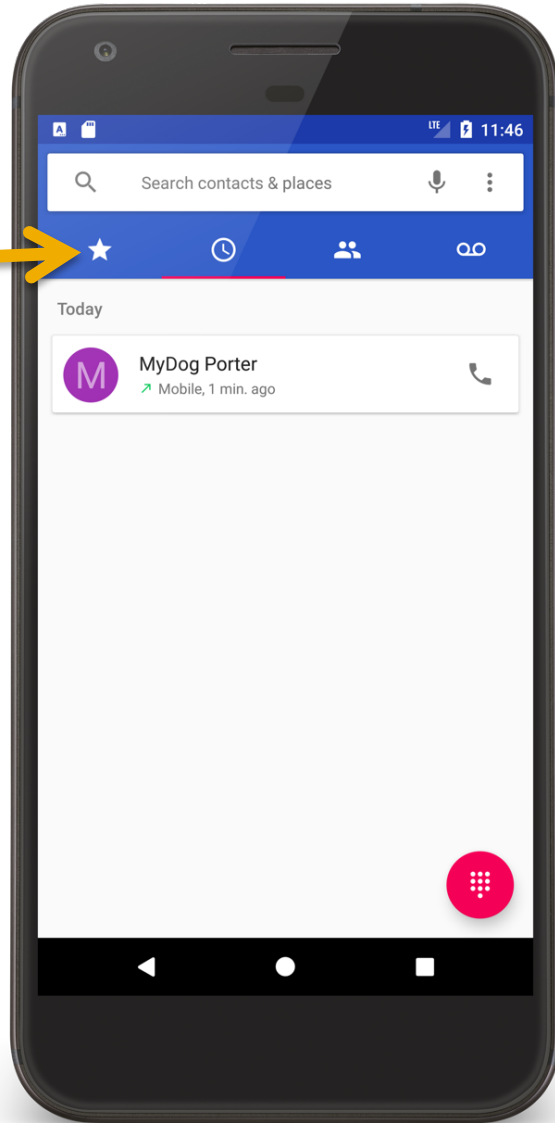


View System

Provides common user interface elements

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

Tabs

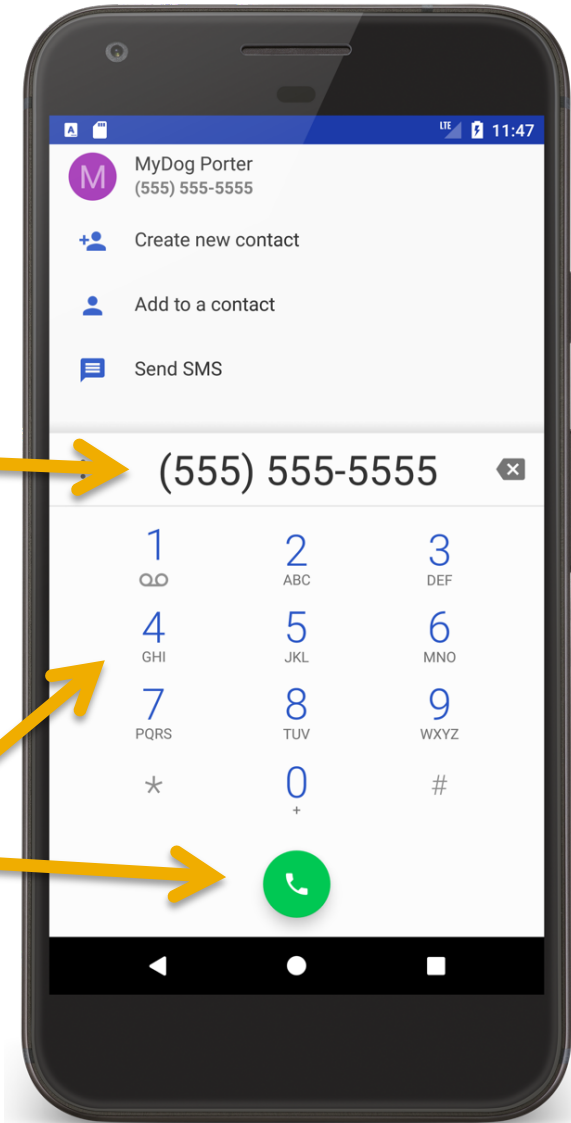


TextView



(555) 555-5555

Buttons

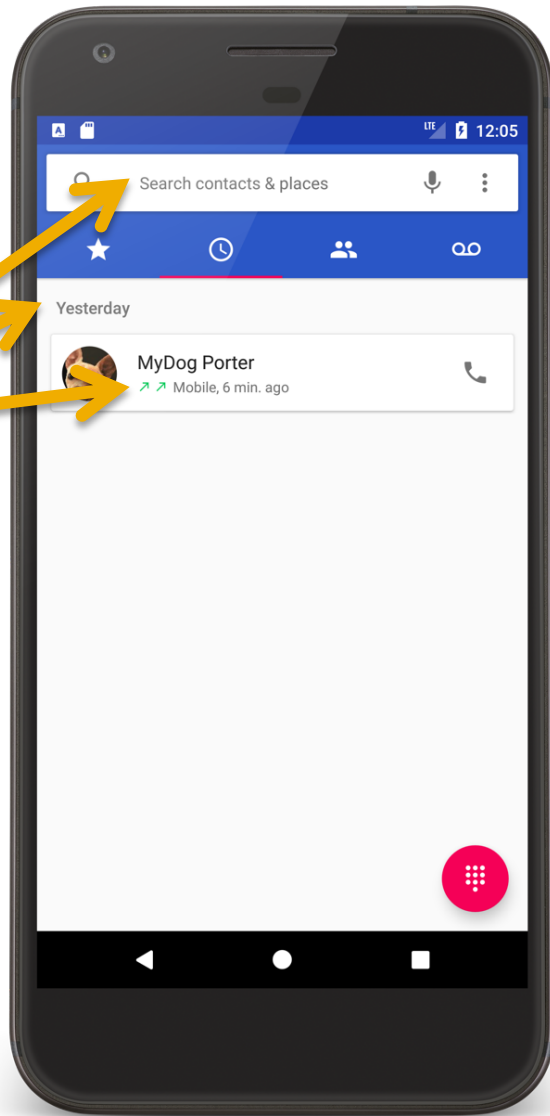


Resource Manager

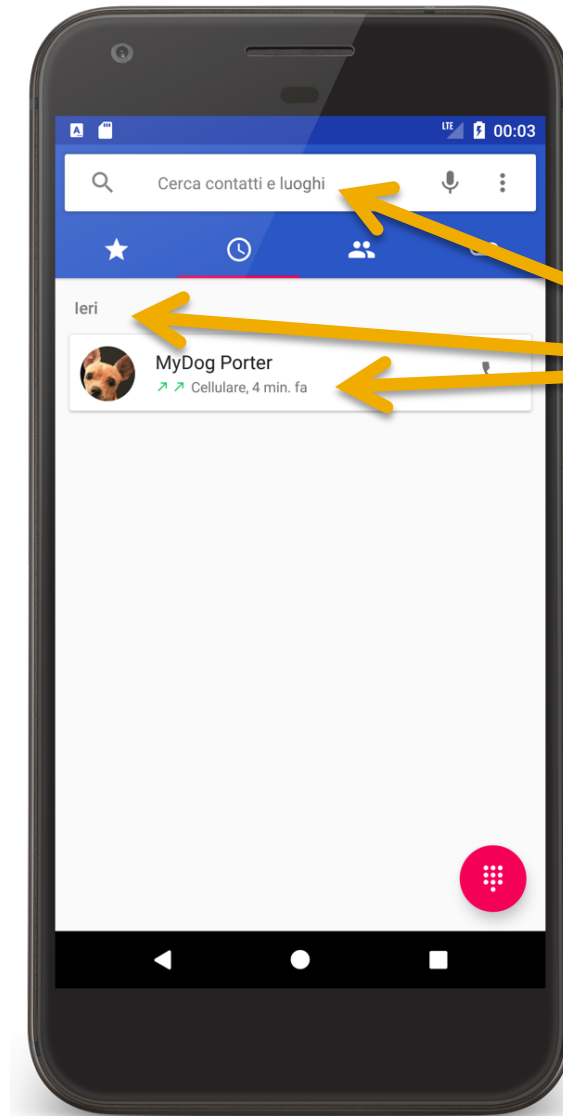
Manages non-compiled resources

e.g., strings, graphics, & layout files

English
Strings

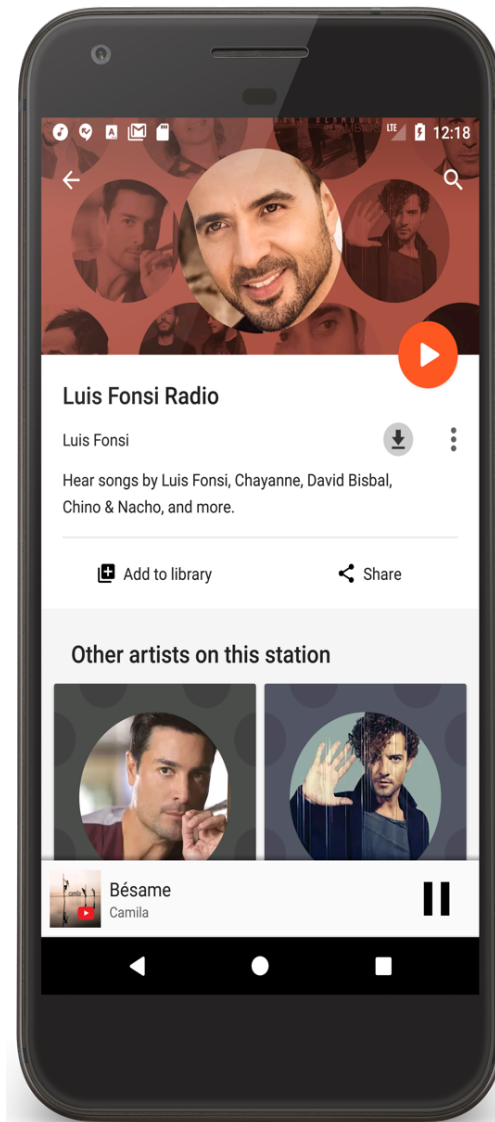
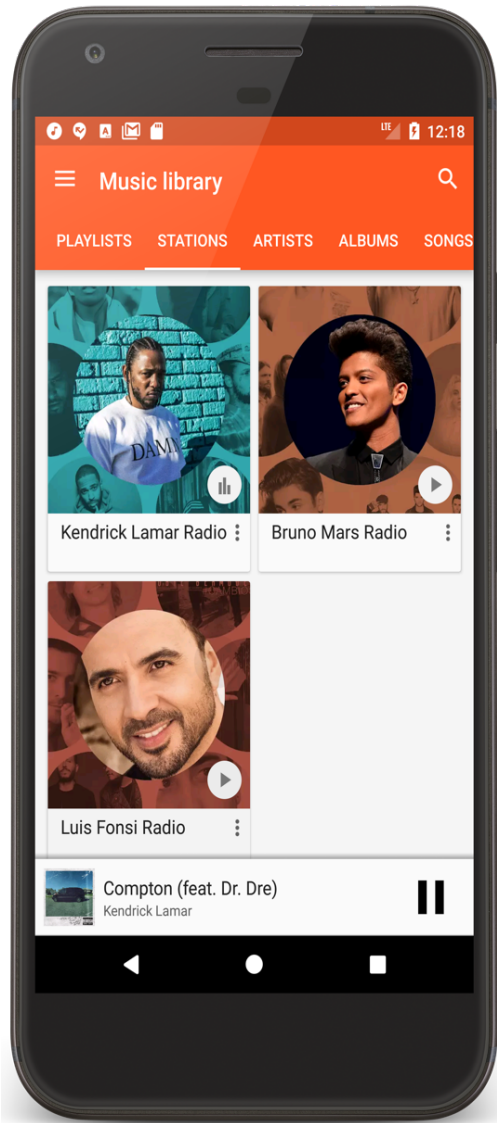


Italian
Strings



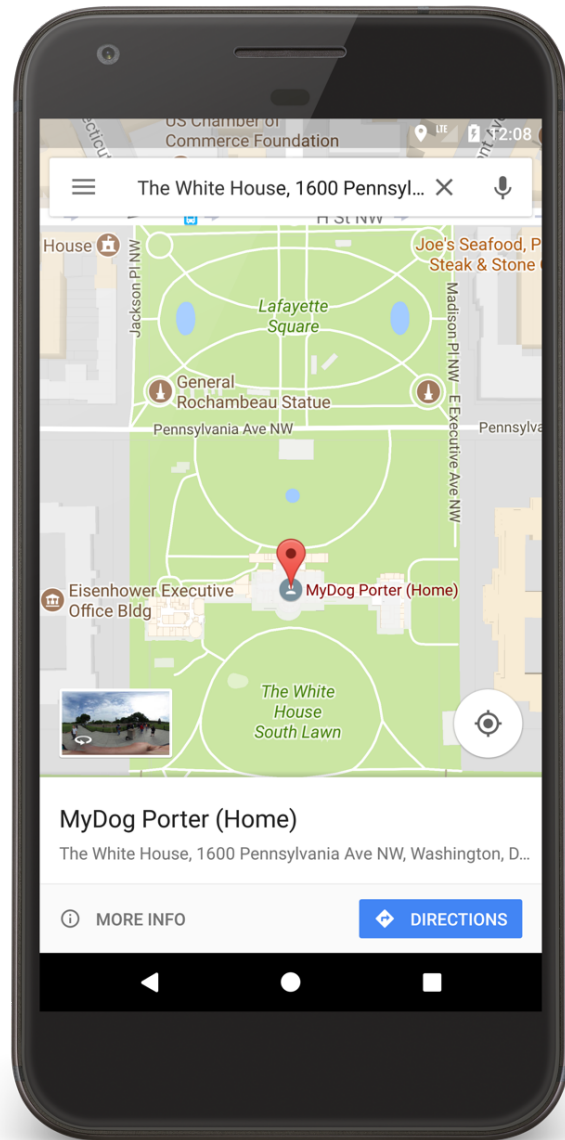
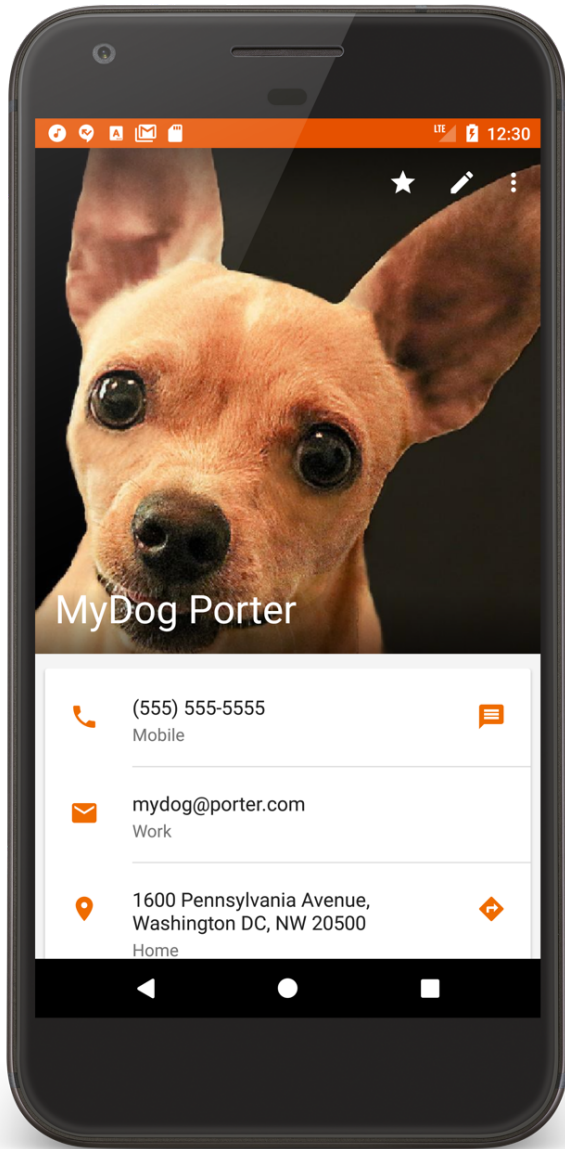
Activity Manager

Manages app lifecycle and navigation stack



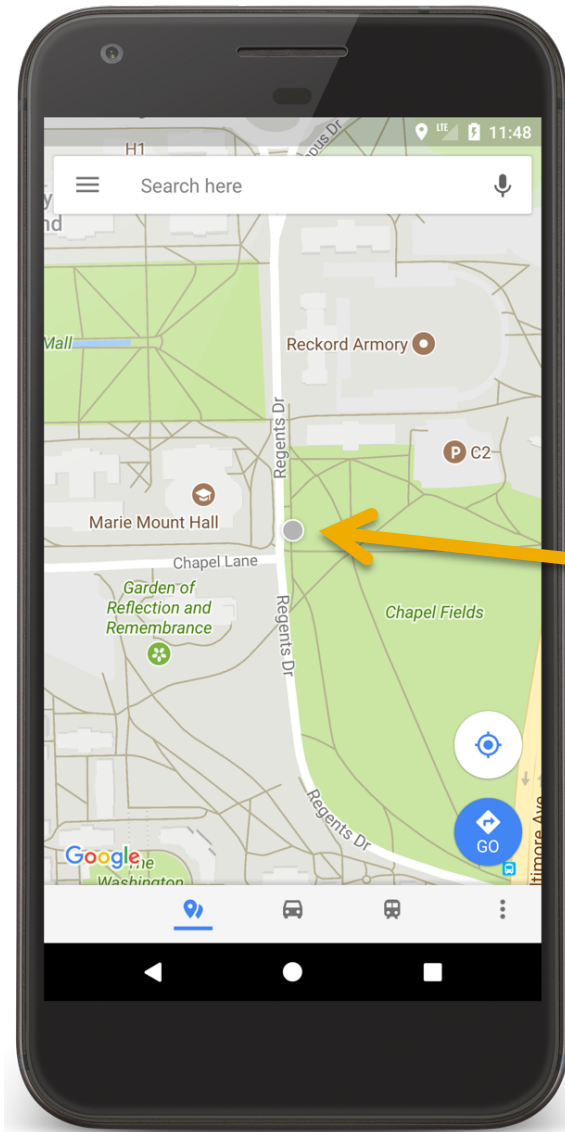
ContentProvider

Inter-application data sharing



Location Manager

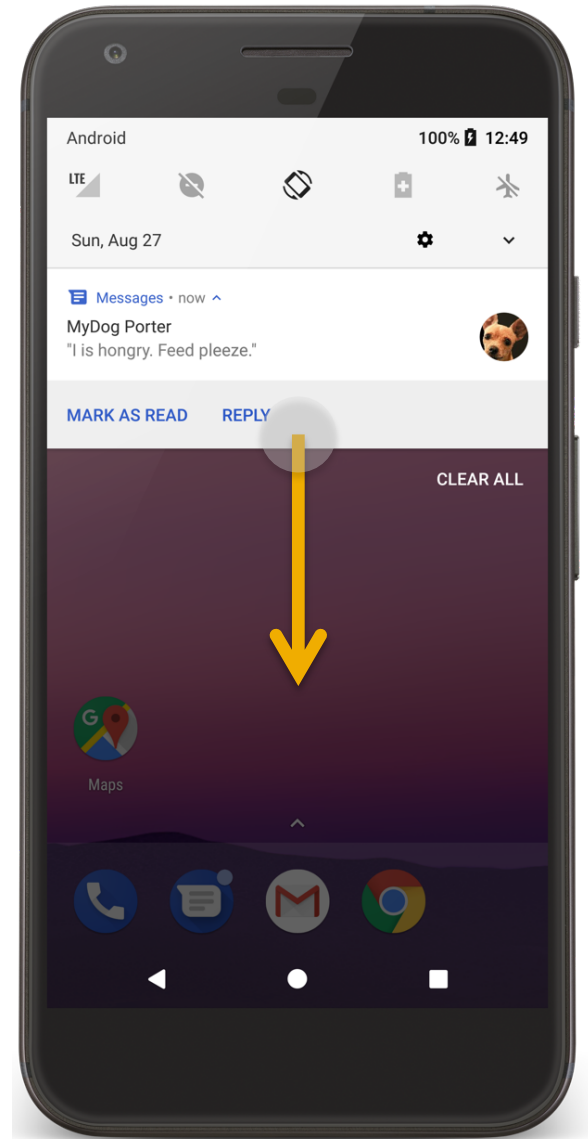
Provides location & movement information



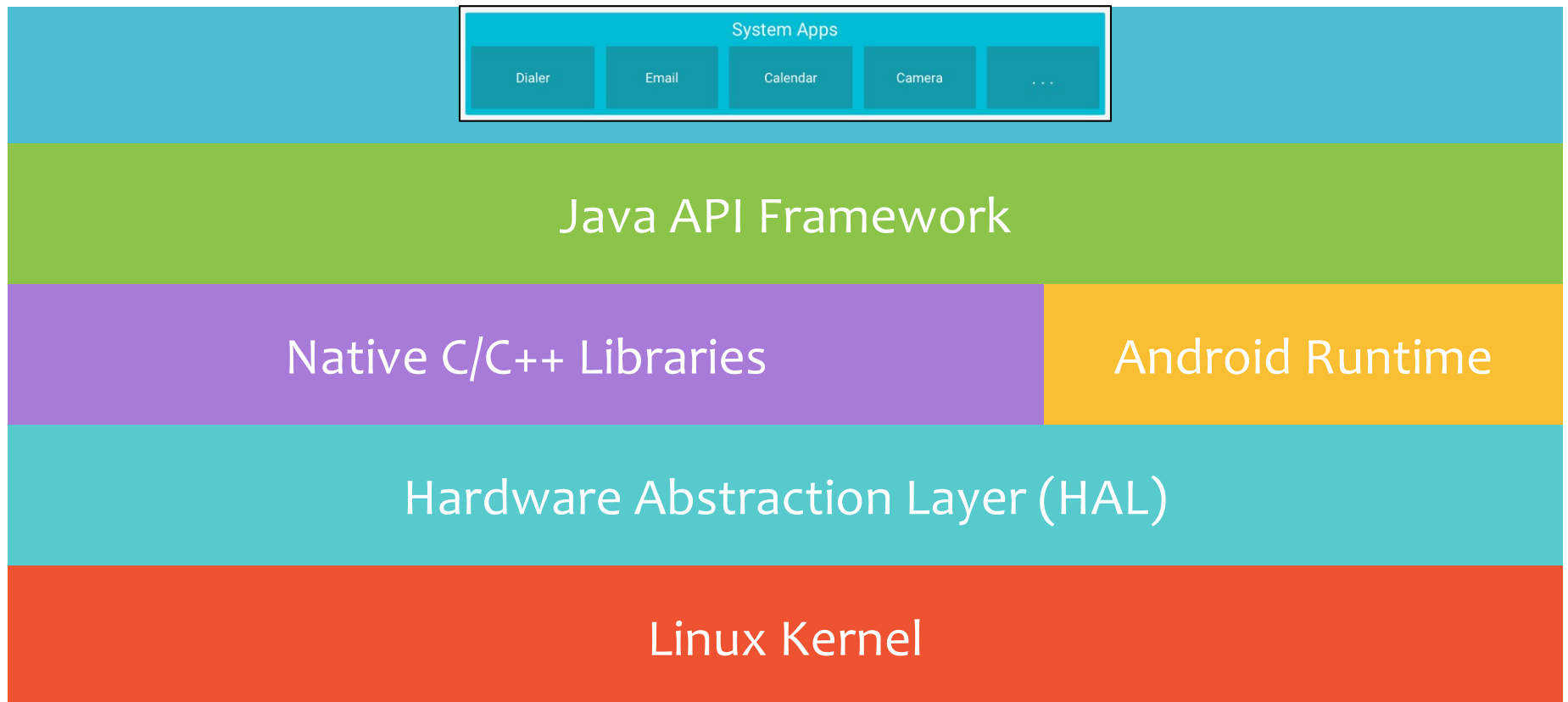
User's
Location

Notification Manager

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



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